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Leadership

Sullivan — pioneer and pacemaker in the field of coal cutting machinery — marches on to new standards of modernization! To Sullivanize means to modernize. In captivating the market these new machines — all practically less than two years old, each with many new features, modern features found in no other machine — have definitely established Sullivan in a position of leadership.

Illustrated (top left) 7-AU Universal Track Cutter; 6-B "Master" shortwall; trucks; 7-B "Super" shortwall; 5-B "Buddy" light duty; 8-B "Dual Duty" shortwall, longwall, and CLE-5 longwall.

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TWO MAJOR EVENTS!!

The American Mining Congress announces the dates for its two great Conventions and Expositions for 1937—one for the Coal Mining Industry; the other for the Metal Mining Industries.

Coal's Convention and Exposition

Music Hall, CINCINNATI, Ohio

May 17-20, 1937

Metal Mining's Convention and Exposition

Minerals Building, SALT LAKE CITY, Utah

September 6-9, 1937

These two meetings offer the maximum return to those interested in the sound and efficient development of our mineral industries.

MAY . . . SEPTEMBER . . . 1937

THE AMERICAN MINING CONGRESS
Munsey Building
Washington, D. C.

WHEN UNDER-EQUIPPED..

When under-equipped you operate with your hands in chains. Modern Robins ore-handling equipment, serving modern crushing and metallurgical machinery, is raising plant capacities, cutting crushing costs, and taking the kinks out of closed-circuit reduction crushing. Send for a Robins representative and let him tell you the story.

ROBINS MAKES:

Belt Conveyors
Gyrex Screens
Robins-Oro Feeders
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Grab Buckets
Ore Bedding and
Reclaiming Systems

Robins Conveying Belt Co.
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37 WEST VAN BUREN ST. CHICAGO, ILL.

MATERIAL HANDLING ROBINS EQUIPMENT

SEND FOR BULLETINS DESCRIBING PRODUCTS OF INTEREST

The Mining Congress Journal

Julian D. Conover, Publisher
E. R. Coombes, Editor

James F. Callbreath — Glenn B. Southward
Albert W. Dickinson — Harry L. Moffett
B. E. Chambers

Vol. 23 JANUARY, 1937 Number 1

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Coeur d'Alene District, Idaho

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The pacemaker in wire rope development

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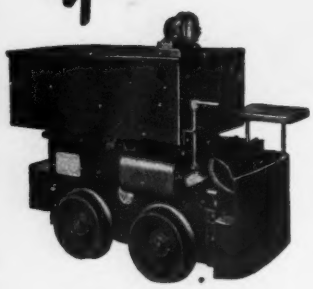
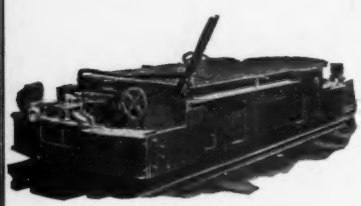
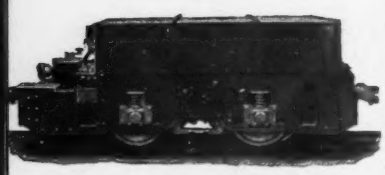
Every type— Any size you need



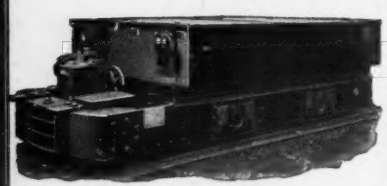
Storage-battery, Trammer



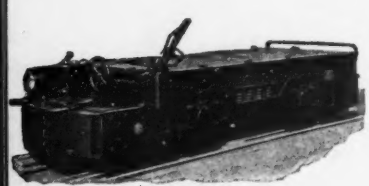
Cable-reel, Sealed Equipped



Storage-battery, Open Type



Storage-battery, Permissible



Trolley, Haulage

Are your motors running up power costs?

THAT'S a fair question—one in which we know you're interested. If they're G-E motors, you can be confident that you're getting maximum haulage from your power dollar. G-E mine locomotives are ***power savers*** because of their designs and fine construction details—details such as special insulations to cut leakage losses, and high-quality materials to increase mechanical and electrical efficiencies.

In haulage from the coal face, whether loading is done by hand or machine, you need equipment that gets the loaded cars out and substitutes empties with no lost time. You can be sure that G-E gathering locomotives are equipped with motors of the proper speed and power to do the job right and still keep costs low. Over-motoring for increased speed is expensive.

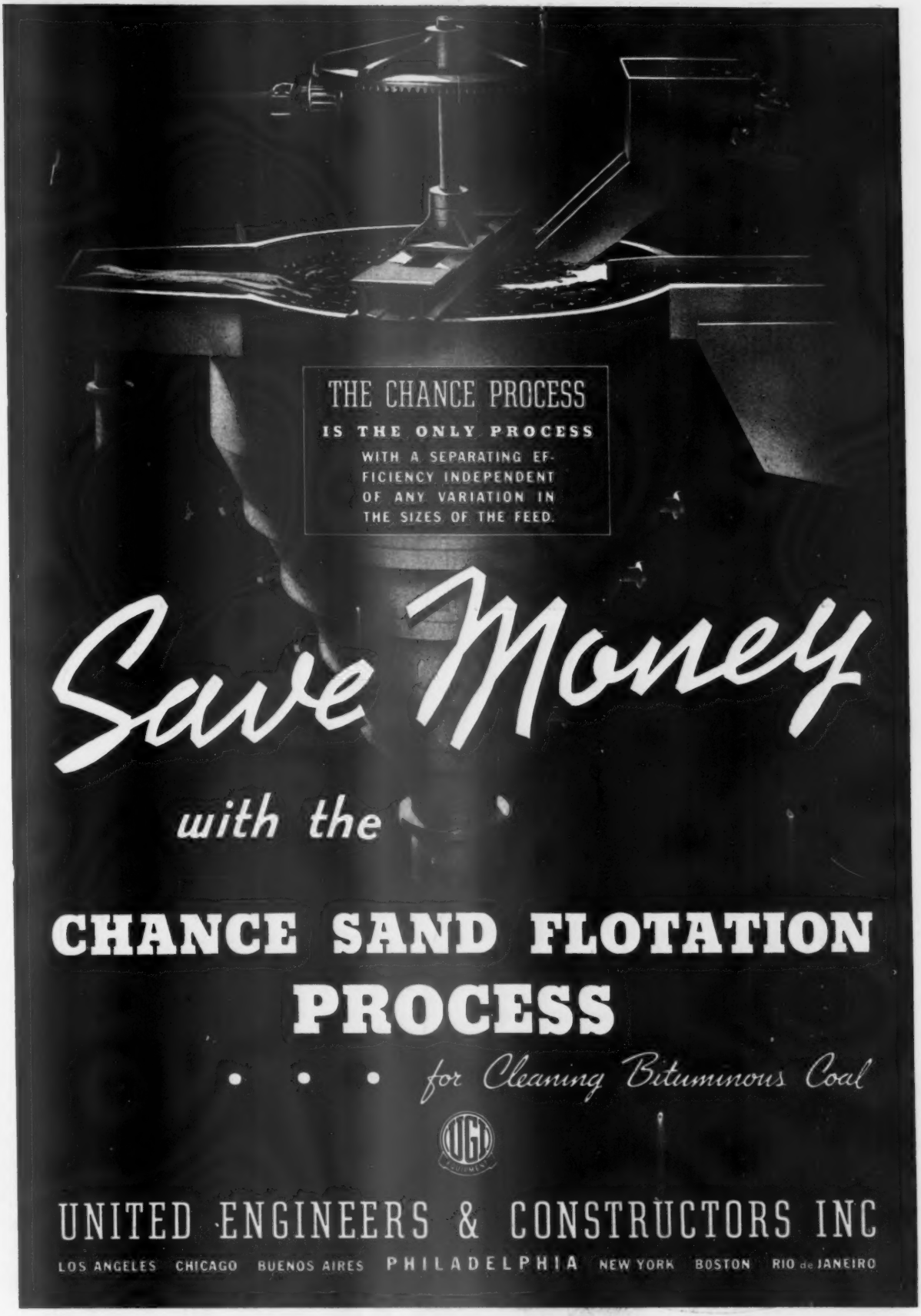
Our engineers have overlooked no opportunities for power economies in the design of G-E mine-locomotive equipment. These power savers help to reduce your demand requirements—help to give you more economical production.

General Electric manufactures a complete line of mine locomotives embodying nearly fifty years of experience in the design and manufacture of thousands of locomotives. Your nearest G-E sales office will be glad to give you more information. General Electric Co., Schenectady, New York.

MODERN HAULAGE EQUIPMENT MEANS FASTER, MORE ECONOMICAL PRODUCTION

190-11

GENERAL ELECTRIC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WITH A SEPARATING EFFICIENCY INDEPENDENT OF ANY VARIATION IN THE SIZES OF THE FEED.
Save Money
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CHANCE SAND FLOTATION PROCESS
• • • for Cleaning Bituminous Coal
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LINK-BELT

BRINGS LOW COST TO EVERY STEP IN COAL PRODUCTION

Night photograph of Link-Belt Simon-Carves Washery and Tipple. Island Creek Coal Co., Mine No. 20, Holden, W.Va. One of three such Link-Belt plants for this company.

STRIPPING
DUMPING
CONVEYING
DEDUSTING
CRUSHING SIZING
PICKING
CLEANING
DRYING
BLENDING
LOADING

● As modernization proceeds in the industry, it becomes more and more apparent that the unmatched experience and facilities of the Link-Belt organization are earning the preference of coal operators everywhere. Regardless of the nature of the problem, Link-Belt has the background and the equipment to produce uniform coal of high BTU value at the lowest cost.

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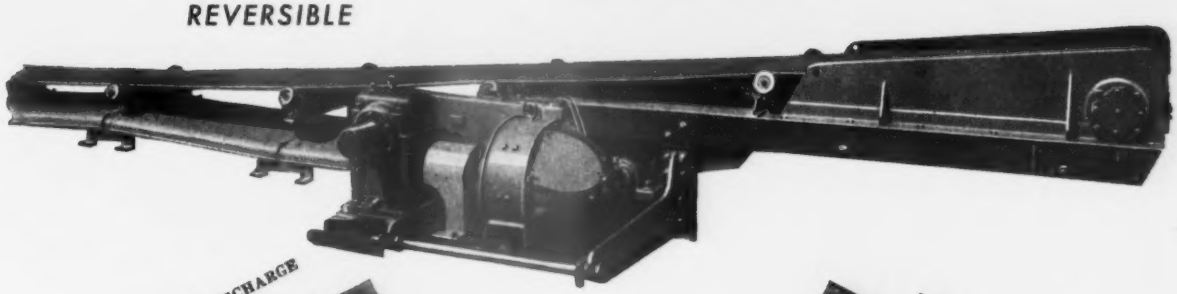
1910

Preparation Equipment

GOODMAN Semi-Trough Belt Conveyor

BUILT FOR THE HARDEST GATHERING SERVICE . . .

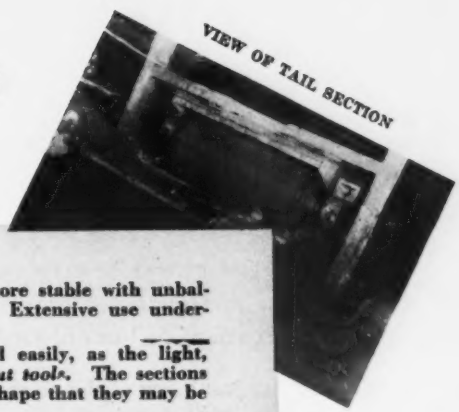
EASILY DISMANTLED
•
REVERSIBLE



Top illustration shows Driving Head, Power Unit, and Loading Boom or Jib.

LOOKING TOWARD DISCHARGE END

VIEW OF TAIL SECTION



The Goodman Semi-trough Belt Conveyor is more stable with unbalanced loads than the standard trough design. Extensive use underground has demonstrated its practicality.

This sturdy gathering conveyor may be moved easily, as the light, short sections can be taken apart quickly *without tools*. The sections of this conveyor are small enough and of such shape that they may be carried on the belt.

This type of conveyor may be built for lengths of 2500 feet—or even longer, if necessary. Part of the conveyor may be set up to start a run and sections can be easily inserted as the work progresses.

The power unit may be set up on either side of the conveyor. The belt is reversible, so that supplies may be taken to the face.

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GOODMAN

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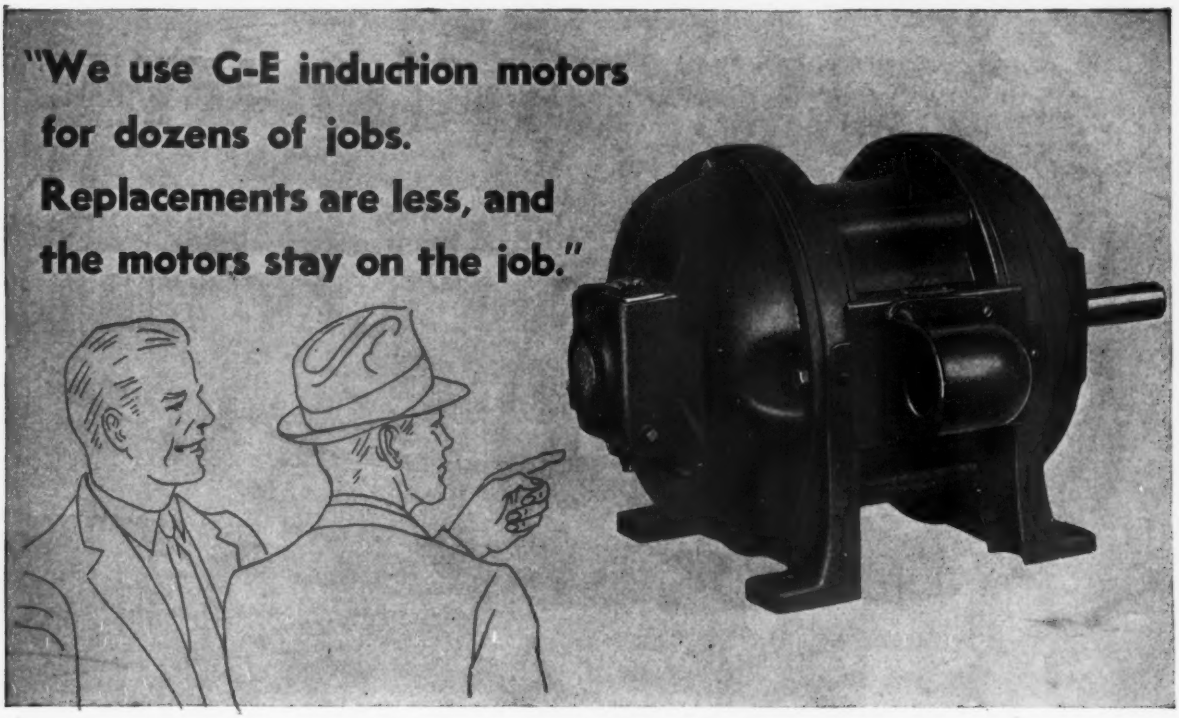

MANY WAYS to Get Lower-cost Tonnage with G-E MOTORS

G-E INDUCTION motors have so many applications in mining operations that their use provides an important means of reducing the cost per ton of coal or ore handled.

For example, here are just a few of the machines on which they are used:

DRAINAGE PUMPS	SHAKER SCREENS	COMPRESSORS
GATHERING PUMPS	HOISTS	CLASSIFIERS
VENTILATING FANS	LOADERS	CAR DUMPERS
CONVEYORS	CRUSHERS	ROCK-DUSTING MACHINES

Note the features listed at the right that assure long-time performance at low maintenance expense. Wherever you have one of these motors in operation, you can be confident that it is giving efficient, reliable service.

Other G-E products that help give low-cost tonnage in modern, mechanized mining are d-c motors, synchronous motors, cable, control of all types, mining locomotives, switchgear, power rectifiers, transformers, substation apparatus, and lighting equipment. Call the nearest G-E representative for further information. General Electric, Schenectady, N. Y.

G-E Induction Motors Have These Features

- Strong end shields
- Rigid frame
- Indestructible cast-aluminum rotor
- Special high-quality insulation
- Easy to disassemble
- Can be lubricated without exposing bearings

020-308

GENERAL ELECTRIC

THE REFLECTION OF ENDURANCE IN MODERN MINING EQUIPMENT

The Timken Bearing Equipped symbol reflects long life in every piece of mining equipment with which it is associated.

In leading makes of mine cars, belt conveyors, loaders, hoists, pumps, compressors and other types of equipment, Timken Bearings safely carry all radial, thrust and combined loads; hold moving parts in correct and constant alignment; simplify and economize lubrication; assure smooth, power saving operation under all conditions; and cut maintenance costs to the bone. Timken pioneered tapered roller bearings in mine cars 17 years ago. Since then over 250,000 Timken-equipped cars have gone into service in 1,000 mines. No other anti-friction bearing can even approach this record.

To make sure of getting Timken endurance in your new mine cars look for Timken Bearings—and the Timken Bearing Equipped symbol.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *TAPERED ROLLER* **BEARINGS**

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THIS NOFUZE CIRCUIT BREAKER IS

Saving $10 A MONTH

...IT Cost only $29

HERE'S THE RECORD

A 6½-hp. d-c. motor drives a rope hoist for car "spotting" in loading yard of large anthracite mine. Circuit was protected by fused switch and blown fuses were frequent. Resultant cost in lost man-hours, delays, and frequent burn-outs of motor armature averaged $10 monthly. A Nofuze breaker, costing $29, was installed and *eliminated these losses.*

Your workmen need never open a Nofuze Breaker to restore service . . . all operations are accomplished by an external handle. Complete safety is assured circuits and operators because of the breaker's high arc-rupturing capacity, and because all parts are totally enclosed, mechanism is trip-free and tamper-proof.

IMPORTANT ADVANTAGES THAT BRING

Savings+Safety

- Save lost man-hours—no idle workmen waiting for power to be restored.
- Save lost machine-hours—and machine-hour rates are usually greater than man-hour rates.
- Save installation costs—Nofuse breakers require 40 per cent less space than fused switches. Easy to install.
- Save production delays—of growing importance today with business upswing.
- Save fuse costs—nothing to renew or replace.

IMPORTANT SAVINGS plus real SAFETY. That's why more than 1,000,000 Nofuze circuit breakers have gone into service since Westinghouse initiated this revolutionary method of circuit protection.

Scores of users report new standards of safety . . . and quick savings far greater than the cost of breakers themselves. And no wonder. When you banish fuses with Nofuze breakers, you end fuse-outage losses automatically . . . safeguarding production and saving time lost by men and machines.

It will pay you to specify "Nofuze Circuit Protection" when you install new equipment or revamp the old. For proof, call your

WESTINGHOUSE OFFICE OR ELECTRICAL JOBBER
WESTINGHOUSE INDUSTRIAL AGENT

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WESTINGHOUSE 1886 W 1936 GOLDEN JUBILEE

Westinghouse

NOFUZE CIRCUIT BREAKER

--but O-B Overhead Materials Can't

NO "easy living" in the destiny of overhead line materials! That is why O-B engineers have planned, and O-B craftsmen have built, extra life into all of the overhead equipment bearing the O-B trademark.

This extra life means extra years of efficient service on your behalf--extra life that brings you extra profits, invisible profits, which flow back into your pockets just as surely as the profits from the sale of the coal itself.

Take a look at this line-up at the bottom of the page! All of these devices are as durable, as efficient and as strong as human ingenuity can possibly make them--ready to take their place in your haulageway--ready to insure you a continuous and an economical haulage flow for many years. It is because of this extra life that so many mines have standardized on O-B overhead materials. We welcome the opportunity to furnish you with complete information on any or all O-B products.

OHIO BRASS COMPANY

MANSFIELD, OHIO, U. S. A.

Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont., Canada

1091M

O-B's Extra Life Brings You An Extra Profit

Improved Menzies Hydro-Separator

FOR WHICH WE ARE EXCLUSIVE AGENTS

Improved Menzies Tandem Hydro-Separator, used for cleaning 4″ x ⅜″ Coals

- **Capacity 100 tons per hour**
- **Simplest and cheapest in first cost**
- **Low water consumption**
- **Low Horsepower**
- **Low maintenance cost**
- **Cleans wide range of sizes**
- **Three parts separation—clean coal, middlings and refuse**

The combination of the improved *MENZIES HYDRO-SEPARATOR for COARSE SIZES*, and our *STUMP AIR-FLOW COAL CLEANER for FINES*, makes the ideal low first-cost coal cleaning plant.

Whether your problems be one of coal washing or cleaning coal by air, our engineers are prepared to find the most effective and economical solution to your problem.

We invite your inquiries and unlimited use of our consulting service and testing plant and laboratory, without obligation to you.

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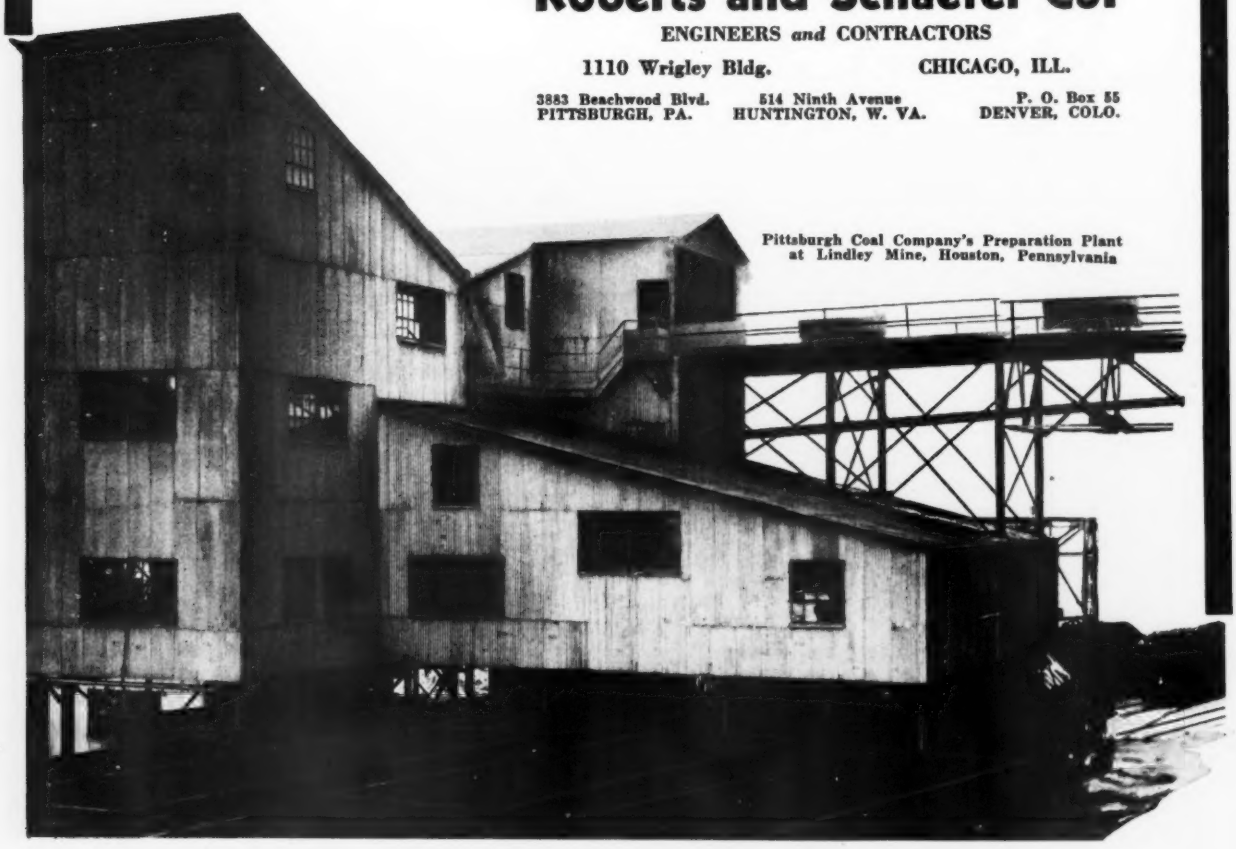

Pittsburgh Coal Company's Preparation Plant at Lindley Mine, Houston, Pennsylvania

THE NEW YEAR

PROPHESY is always unsafe, but we may assume that the changes which our government has undergone and such as are now in process have come to stay.

By a natural process our nation has been divided into states each of which, under the Constitution, was endowed with the entire control of its domestic affairs.

Each state had its own Constitution and carried the responsibility for, as well as the power, to make its own laws, to provide means for their execution and to fix penalties for violation.

Without such safeguards the Constitution could not have been adopted, and a considerable resistance to and delay in its adoption was made by some of the states which insisted on more definite protection of state control. Our Civil War was fought not over the question of state control of police power but over the question as to whether the right to withdraw from the Union was also included as an original right under the Federal Constitution.

Home rule for each state unit has not been seriously questioned until within the last few years. Under the guise of public necessity brought about by a world-wide business depression, serious departures from the established relations with the Federal Government have been inaugurated.

The recent election gave overwhelming approval of the acts of the people's representatives in Congress in giving wide authority to the President.

It will be for the people to determine the extent to which the always omniverous desire for increased authority by the National Government shall be satisfied.

The present trends are not new, nor are they the acts of any one political party. It was President Theodore Roosevelt who justified the theory that when any state failed to exercise its inherent power for the good of its citizens, the state's failure furnished justification for an assumption of that power by the Federal Government.

In any widely flung country the difference between democracy and autocracy is measured by the extent to which power is exercised by the central government.

Complete central control is autocracy which is but another name for dictatorship. The failure of many peoples to appreciate and exercise the responsibilities of democracy opened wide the door to the dictatorships which are now the leading and aggressive forces in the world.

Whether the American Republic shall survive the turmoils of the world disturbances will depend upon the fidelity and effectiveness of the opposition to proposed changes in the fundamental principles which have served so well in the past.

The New Year, free from political contest, will furnish ample time for discussion and consideration of this most vital problem.

The Mining Congress Journal

Volume 23 JANUARY, 1937 Number 1

E. R. COOMBES, Editor

A Journal for the entire mining industry published by The American Mining Congress

The Legislative Hopper

WITH THE CONVENING of Congress on January 5, many new faces appeared in Congressional circles, and many familiar faces were conspicuously absent. Hundreds of bills were presented on the opening day, many of them suggesting entirely new types of legislation; others were quite familiar, and changed only by their new form. To the casual observer it would seem that previous sessions had preempted all possible legislative proposals, but a glance at the record dispels that idea, and indicates that the surface has merely been scratched.

Many committees and commissions are now studying conditions, and some of them will report their findings to the President early in January. All of this will have a distinct bearing upon the legislative program.

Of one thing—and one thing only—may we be sure; there will be a tremendous number of bills presented to Congress that will intimately affect all our lives. It behooves each and every one of us to know about these proposals and to make our views known to members of Congress. The legislative rush is just in the offing and it will be the better part of valor to be prepared for the avalanche.

A Different View

A RECENT STATEMENT by a leading coal operator is well worth repeating, for it gives a new picture of the coal industry, which has ceased to be the backward, sometimes wayward child and has become the efficient example. We quote:

"The coal industry is rapidly taking its place among the country's most progressive and modern industries. . . . Coal mining, as we know it today, is manufacturing on a mass production basis. Machines, operated by experts, perform the work formerly done by men with hand tools. This is true underground, as well as on the surface. The old-time miner is being succeeded by those who can operate and repair mechanical and electrical machinery. The modern mechanical preparation plants are turning out sizes and grades of coal for every purpose; these sizes are clean and frequently dust-proofed. When burned in the modern stoker, they furnish automatic, clean and convenient heat.

"This modernization program has created the largest market for coal mine equipment that has ever existed. Over a period of a comparatively few years, hundreds of millions of dollars are to be, and are being, spent by the industry on its mechanization program."

The revolutionary changes in safe and efficient production and preparation methods now taking place, together with the constant application of research, is today making coal one of the country's truly outstanding industries.

Labor and the Future

IT TAKES LITTLE imagination to follow the powerful desires of those heading up the labor movement. If achieved, the power labor could—and would—wield would be phenomenal, for there are in this country in normal times more than 30-million eligibles for membership in labor unions.

Because of wise, intelligent leaders we have grown to the greatest country in the world. Workers of all classes have the finest living and wage standards. They have the greatest of opportunity, for no worker is so humble that he cannot, through industry and brains, reach the highest pinnacle of success. It therefore is of more than grave concern when we find leaders of labor urging that politicians be permitted to fix the amount industry shall pay for its help, the hours they shall work; that industry shall conduct its affairs by political permission through a license system that shall tell it how, when and why its capital shall be spent; and that industry be saddled with various and sundry reforms.

One of labor's slogans has been "no backward step" and it should exercise the greatest of care at this time that its leadership shall be forward.

Regulation of Business

THE SECRETARY OF COMMERCE, Mr. Roper, recently said that one of the major problems of the Administration is that of "regulation of business to maintain competition while preventing that competition from destroying itself." Although the Secretary does not indicate how this may be accomplished, it is obvious that he anticipates new legislation to help make it effective.

A review of legislative history will indicate that for many years the trend toward centralization of power in government has been on the upswing. Its growth over the last 50 years has been spasmodic, but the last four years have seen a blossoming of the plant. Each era has developed its advocates of the idea. The Sherman Anti-Trust Laws, including the Clayton Act, the Federal Leasing System, and the more recent establishment of bureaus and commissions to regulate industry procedure, are points in fact. The late unlamented NRA is the latest type of Government regulation proposed. Developments of the next few months should indicate the trend of the Administration's thinking in regard to Mr. Roper's idea. Obviously we are in for an era of experimental legislation that promises more confusion than solution.

Today's Problems†

By WILLARD CHEVALIER*

TURNING first to internal problems, we find that during the last year the metal-mining industries have enjoyed a substantial measure of prosperity, principally in the field of gold and silver production, and chiefly as a result of the monetary policies of the Government. A year ago mining as a whole was awaiting anxiously and hopefully an extension of that prosperity into the field of the major non-ferrous metals. That hope has been realized in substantial degree; 1936 has brought us an appreciable improvement in the domestic demand for copper, lead, and zinc.

This improvement in demand reflects an industrial revival which now has come to include those heavy industries that traditionally have been large consumers of metal products. Today the sales of electrical energy are above those of 1929 as well as those of 1935. The electrical equipment industry, the automobile industry, and the construction industry together are prime factors in the metal market and all of them are on the up and up.

But right here, as we consider that statement, is revealed one of the problems that now face the metal-production industries. For many years the facilities of these industries have been taxed to produce a supply of the basic metals required to meet the needs of national industrial expansion. The demand has been for the metals themselves as fabricated directly into various types of productive and service facilities.

We have needed, for example, copper, lead, and zinc as such, for the more or less obvious and traditional uses of those metals. But during recent years we have been witnessing a significant change in the nature of competitive manufacturing and selling. Once the producer thought almost wholly in terms of a naturally expanding demand for his product and of competing for his share of it with other producers of that product. We assumed his market; his concern was to get his share.

But as a nation approaches stabilization of its physical development, the nature of its domestic demand is prone to change. The so-called natural demand for the obvious and traditional uses tends to decline or to grow less rapidly; new markets must be sought in new uses; old markets must be protected against invasion, not only by competing producers but also by competing products. Competition and survival then become matters of research to determine new properties, new combinations, new uses, new processes, and new trading practices, of education to popularize new materials and new methods and of eternal vigilance to keep competing materials or methods from outflanking the positions we now hold.

The Threat of the Substitute

It is a commonplace of modern industry that ever so often some industry awakens to recognize that some use for its product has been wiped out by the development of a substitute. Today, for example, metals are finding increasing competition from plastics. Many small items of metal trimming on automobiles now have been replaced by molded plastics. The electrical industry also is using plastics rather than brass and other metals.

As in other fields of human endeavor, eternal vigilance alone is the price of safety; no industry, however basic it may consider itself or however fundamental may have been its past contribution to our progress, can afford to become complacent in the face of technical progress. A constant study of what is being done by competitive industries with possible substitute products surely is one of the current problems of the mining industry.

It is quite true that in some of the metal fields admirable progress has been made with counter-offensives against such assaults. Through research, cooperative design, general education, and promotion much headway has been made on new uses and applications of the several metals. Part of the industry has developed over the last decade a genuine recognition of the part that research and promotion must play if the technical and production genius of the industry is to enjoy ample scope for its full exercise. But there is still room for a more widespread and intensive application of these principles in many directions.

It will be evident, of course, that the recognition of such a problem will involve a raising of sights by the metal-producing industry to see beyond the process of mining and milling and smelting its ores. It involves the development of a merchandising viewpoint and promotional skill that will be commensurate with the technical resourcefulness and competence of the production minds that have governed the industry's operations in the past. It will see the product of the mining industries not merely as tons of ore or even as pounds of refined metal, but also as thousands of potential structures, facilities, and gadgets that will serve the industrial, commercial, and domestic lives of the American people. Only as we supplement the sustained technical and production efficiency of the industry by the sweep of such a vision can the mining industries be assured of the stability and consistent progress of which its technical staffs are capable. Thus only can their efforts be directed from the beginning toward ends that will be in harmony with the general progress and thus only can they be assured of the continuity of demand that means so much in the metal industries.

The Development of Alloys

In this connection it is significant that during the last few years new technical developments are opening new markets in the use of ferro-alloys. It is true that we do not produce domestically all of the metals that go into these alloys, but among those we do produce are molybdenum, tungsten, and magnanese. Colorado is the largest producer of molybdenum in the world. While tungsten still comes chiefly from the Orient, the United States is supplying an appreciable amount of its own requirements from domestic sources. Technical progress in the production of manganese from low-grade ores points to the possibility that we may soon find a means by which to utilize our large reserves of such ores.

The whole field of alloys is under active research by metallurgists, and as more and more knowledge is gained in this field, there will be increasing demand for alloying metals. Non-ferrous alloys also are coming in for considerable attention. Beryllium is being used successfully with copper. Cadmium, formerly used as a plating metal, has been found to make good bearing alloy.

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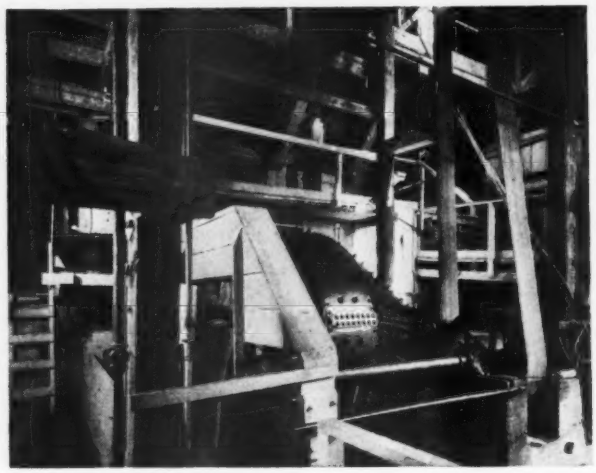
* Vice president, McGraw-Hill Publishing Co.



Interior of Mill, Carson Hill Gold Mining Corp.

Considerable research is being done on industrial uses for silver, sponsored by large domestic silver producers and carried on at the Bureau of Standards. Silver, incidentally, is being used with cadmium in bearing metals. The nonferrous field stands to prosper from such a development and one of the problems of the mining industry today is to keep abreast of these developments and do what it can toward stimulating and discovering new uses for the less common metals.

Governmental Cooperation

As the mining industries have to do with exhaustible and nonreplaceable natural resources, a current problem of increasing urgency is that of formulating a sound mineral policy for the nation on the broad ground of rational conservation through economic use. If we are to make the most of our remaining natural resources, we shall require the closest kind of cooperation between producers as individuals and between the producers as a whole and those agencies of government that may be set up to supervise and regulate the use of the natural resources. To accomplish this, it is quite possible that in the mining industries will be found a legitimate field for amendment of the anti-trust laws and for the establishment of some form of governmental cooperation that might have no justification or place in the manufacturing industries.

Certainly there is a place for authoritative governmental review of the production and demand of metals for quarterly or semiannual periods and for the establishment of certain criteria of production that will help us to guard, on the one hand, against scarcity, and on the other against excessive and wasteful production. Here is neither the time nor the place to consider this problem in detail. Neither is it possible to draw hard and fast lines as to the proper areas of such cooperative effort. But we may declare with certainty against any invasion by government of the operating field, so far as concerns the actual technique and management of production. The objective to be sought in such cooperation is the preservation of the incentives and efficiencies of private enterprise and management while we protect the industry against the suicidal tendencies of competitive efforts that see the day's work only in terms of the day's profits and that have no concern for what may happen to the long-term welfare of either the nation or the industry if they can but collect their pound of flesh on today's platter. Such tendencies may correct themselves in other industries, but they are peculiarly fatal in the case of the exhaustible natural resources.

The Background Problems

But as we consider this matter of governmental cooperation we find ourselves turning from the internal affairs of the mining industry to the more general background problems. What are some of the issues? The fact is that the impact of the World War and the ensuing period of economic adjustment have subjected certain fundamental structures and operating practices of our modern industrial economy to a highly exaggerated and accelerated test. Under that impact many of these structures and practices have either broken down utterly or failed to a degree that has inflicted grave distress on all.

One school, for example, draws the conclusion that the existing order is obsolete, that it is a demonstrated failure, that the legitimate and realizable aspirations of twentieth century humanity never can be achieved under it. Another clings to its conviction that the existing order constitutes the most perfect of worlds and that any "tinkering" with it is but to open the road to chaos. The one would substitute economic planning by the state for the chance and hazard of private enterprise; the other would relegate the state to its original function of merely keeping the ring clear for the free play of individual enterprise and energy. The one holds that we no longer can trust private enterprise to keep the economic ship on an even keel and that government must take a firmer grip on the wheel; the other is sure that unless government goes below and stays below like a good passenger, we never shall get anywhere.

With neither of these schools can I concur, and I am convinced that most thoughtful business men, once they are insulated from the electricity of partisan politics, can see in the basic problems of today something more than a choice between these alternatives.

So, while we keep our minds open to the changing needs of our times and recognize the influence and practical worth of new incentives, we must be careful not to supersede those that men now understand and to which they do respond until, in each case, we have some reasonable assurance as to the efficacy of the substitute. After all, progress is achieved not by the understanding of the highly educated few but rather by the understanding and the acceptance of the great mass of average men. Change to be constructive must be gaited to that understanding and acceptance.

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We must take care that in our efforts to correct the shortcomings of our system, we do not destroy the incentives that now activate men to productive effort. Regardless of what kind of economic system may be conceived for us by the wisest minds, its successful operation always must depend wholly on whether or not men are willing to pour their mental and physical energies into it. And when we violate man's sense of property or tamper with his familiar system of compensation—whether wages, profits, or interest—when we encourage a leaning toward dependence on others rather than toward self-support, and when we put a premium on the obligation of the community to the individual rather than on that of the individual to the community, we are dulling those incentives on which we now must rely for sustained flow of energy that is so necessary to keep the economic machinery at work.

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Power and Machinery

When we turn to our second requirement of an adequate supply of power and plant to multiply our productivity, we find a singular lack of understanding on the part of both the average man and many who should know better. In the face of all our experience, there are those who still believe that the increasing application of power and the development of new machinery and technique are responsible for the periodic visitations of widespread unemployment and its related evils. To combat such fallacy is one of the outstanding problems of

all productive industry. The fact is that during the 60 years from 1870 to 1930 we had in this country the greatest development of new machinery and more efficient industrial technique in all history, coupled with expanding employment and a miraculous rise in the general standard of living.

And to forestall the obvious comment that 1930 ushered in the late destructive depression, it should be noted that the economic collapse that closed the 60-year period never had been traced to the rational and healthy efforts of men to increase their produc'ivity. It was directly due to the perversion and abuse of the credit mechanism in the interest of speculative acquisition.

It is absurd to contend, as some do, that the deflation resulted from our great productivity, when, in fact, it was but the natural reaction from an orgy of credit inflation, a reaction that played havoc with the mechanism of exchange and thus paralyzed the productive industries on which employment depends.

But to confine ourselves for the moment to the question of employment and industrial efficiency, we find that from 1870 to 1930 the population of the United States increased by 218 percent and the number of those gainfully employed increased 291 percent. While the part of the population gainfully employed increased from 32.4 percent to 39.8 percent, the number of children between 5 and 15 years of age gainfully employed or not at school decreased from 10.7 percent to 2.9 percent of the total population and those attending school increased from 16.6 percent to 22.7 percent of the total.

Considering production as a whole, in 1930 some 298 workers per 1,000 inhabitants found employment producing the goods and services demanded by the consumers of this country, as compared with only 324 per 1,000 immediately after the Civil War. This expanded employment, plus the new machinery, the new technique and higher efficiency, has increased prodigiously the volume and variety of the commodities and services available for the comfort, convenience, and luxury of the American people. If we set at 100 the 1870 indices of total population, number gainfully employed and the volume of trade, the corresponding values of those three items in 1930 were 318 and 378 and 1,579, respectively. And by virtue of higher efficiency this increase in productivity was accompanied by a substantial decrease in the working time of those gainfully employed.

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If we examine the 18 principal manufacturing industries that had no existence before 1879, we find employed by them in 1929 one-seventh of all the manufacturing labor. These include electrical machinery, motor vehicles, typewriters, aircraft, motion pictures, computing machines, and many more. In 1879 there were 2,427,000 factory wage earners, or 49,437 per million of population. In 1929 there were 8,839,000, or 72,731 per million. Here is an increase of 6,412,000, or 23,294 per million. But if we consider only the 18 new industries, we find that in 1929 they alone employed 1,123,000 wage earners, or 9,243 per million of population. This constitutes 18 percent of the total increase and 40 percent of the increased factory employment per million of population. This includes only the factory workers. It disregards those who find employment in servicing these new products to users or consumers.

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The New Industries

Unfortunately many are prone to take for granted and to overlook the vast aggregate of absolutely new employment that is created by technical progress and higher efficiency. This is of two kinds: One comprises the great variety of service, administrative functions that accompany the intensive development of industry, and the widening of markets for its products made possible by higher efficiency and lower costs. Transportation, wholesale and retail trade; merchandising, advertising and financing; insurance, telegraph, telephone, and mails; professional and many other services create new jobs in abundance. A comparison of relative employment shows that from 1870 to 1930 manufacturing employes increased from 21.2 percent to 28.9 percent of the total, while agricultural decreased from 53.4 percent to 21.4 percent. But the number employed in distribution and services increased during the same period from 23.5 percent to 47.2 percent of the total.

Interior of Mill, Sunshine Mining Co.

Be it noted that *this increase in the proportion of those employed in manufacturing, despite the vast use of modern technique and machinery,* results from the second type of new employment; i. e., the wholly new industries developed by technical progress to provide the new goods and services required to gratify the desires of a people whose purchasing power has been increased by other technical progress.

These new industries, with all they mean to the lives of our people as well as to employment, never would have come into existence if during those 50 years we had followed a policy of holding back the technical and mechanical progress of our industries.

What Is the Place of Government?

What should be the place of government in an economic society of such extraordinary complexity and interdependence?

As each man becomes more and more distantly removed from personal contact with and influence over the production of those things that he needs to support his very life, how can government provide the necessary social framework within which he can work with reasonable confidence that he will participate fairly in the product of the whole?

Most thinking men will admit today that under these conditions government is bound to take an increasing part in the coordination, supervision, and regulation of the economic agencies. It is impossible for us to revert to the simplicity of government that sufficed 150 years ago. How far shall we go then, and just how can we establish most advantageously a participation by the state in the affairs of productive industry?

It seems to me that the participation of government should be confined scrupulously to that of regulation and supervision with, in certain cases, some measure of coordination. Certainly it appears to be evident that only in rare cases and under great stress of public need should government undertake the actual operation of productive enterprise.

It is not reasonable, of course, to claim for private enterprise a corner on operating ability or skill or to suggest that no public employe can be a competent manager of a productive enterprise. Neither is it reasonable to contend that private enterprise itself always is a perfect vehicle of accomplishment without weakness or abuse. The basis of one's faith in private enterprise and operation is not found in any monopoly of ability

by those who happen to be employed in private enterprise or any lack of it amongst those in public employment. It must be sought rather in the incentives and checks that normally inspire and dominate the two kinds of effort.

The participation of government in productive industry will be of the highest value to the public it serves when it is limited to supervision, regulation, or coordination. Its objective should be to insure that every individual, be he employe, employer, or investor, may feel that he is sitting in a game in which the rules are fairly drawn and will be equitably enforced. But when it comes to the actual processes of production in any field, all the people, in their capacities as both producers and consumers, will do better to rely on those who must labor constantly under the whip of competitive enterprise.

The Basic Problem

If we are to realize that reasonable stability of the entire economic process that will send each man daily to his place of work with a sense of confidence and security, it will be necessary for everyone in every department of industry to play the game according to the rules he professes to respect. It is somewhat inconsistent for us to say we believe in a competitive system and then to use all of our ingenuity to thwart the operation of competition. It is inconsistent for us to say that we believe in free enterprise and then to use every device that we can command to restrict that freedom of enterprise on the part of those who would compete with us. We are not consistent when we accept the institution of credit as the basis for 90 percent of our medium of exchange and then use that credit to indulge in speculation so excessive that we destroy faith in all values and dry up the circulating medium just when it is most needed by the producers and consumers of the nation. It is not consistent for us as individual enterprisers to seek immunity from the operation of these fundamental laws of our accepted economy and then resent and resist the efforts of the community through its government to protect the people at large from the abuses that may result from our efforts.

Here then is one of the major problems of all industry today and of the natural resource industries in particular. It is sufficiently important to warrant the best thought that can be applied to it by the best minds in every industry. And in no industry is the need more urgent, the conditions more favorable and the opportunity for constructive cooperation in the general welfare more promising than in the mining industries.

The Challenge to Liberty

In conclusion, if I were asked to formulate in a phrase what I see as the basic problem of our time, I should say that it is to reconcile scientific liberty, economic liberty, and political liberty.

Through scientific liberty man learns how to apply the forces of nature to increase his productivity; a free science has been the prime mover of the amazing progress that man has made during the last century with his conquest of scarcity. Through economic liberty man seeks to kindle his incentives and to open a way for all of us who will climb to the limits of our strength; in this freedom are nourished the springs of initiative and enterprise. Through political liberty man seeks to insure that government shall be his servant rather than his master; it is his guarantee that he always shall have his measure of power to protect his rights and redress his wrongs so far as they may be amenable to community action.

As Americans we have been taught that the reconciliation of these liberties means the greatest good for the largest number. We have believed that such a reconciliation is feasible. During a century and a half we have made some progress in demonstrating the soundness of that belief, at least under the conditions that have prevailed hitherto.

I hope that we shall renew our faith in the creed of liberty in which we have been nurtured. I hope that we can preserve an America that will be free—scientifically, economically, and politically free. I hope that we shall be able to confound those whose faith has not been equal to the needs of today.

But let us not deceive ourselves. So happy an event is not to be realized by hoping or wishing. It cannot be achieved by turning back the clock to other days or by trying to freeze the social and economic institutions of the day. We can neither be free nor remain free without change; for change is the offspring of liberty.

If we are to reconcile these traditional ideals, we must seek out honestly and courageously what is defective or inadequate in our present set-up; we must determine honestly and courageously what should be done to set it right; and we must proceed honestly and courageously to do just that. The forces of change that are abroad today will brook no evasion. We must turn them to useful purpose or they will destroy us. They can be guided, but they cannot be suppressed. We may delude ourselves; we cannot delude them.

Only by honesty and courage can we hope to master them; only as we master them shall we be enabled to solve the problem that confronts industry today. And only as we solve that problem can we realize that sustained climb to even better things for all which is the prayer of every producing American, be he worker, manager, proprietor, investor, or public servant. Is it worth the effort?

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It is one thing to be handed a certain sum to do a job as efficiently as you can. It is quite another to be required under pain of losing your shirt to do that job sufficiently within a prescribed cost to show a satisfactory profit. It is one thing to hold a position by political favor or under civil service protection. It is quite another to have no security except your ability consistently to produce satisfactory results at low cost. It is one thing to gage that cost by certain general standards of your own setting. It is quite another to have them consistently set for you by the prices of your keenest competitors. It is one thing to have behind you the credit or taxing power of the city, state, or nation. It is quite another to handle your job and come out whole within the limited resources of a private business. In short, it is one thing to spend an appropriation of public funds, however conscientiously, and quite another to survive in competitive enterprise.

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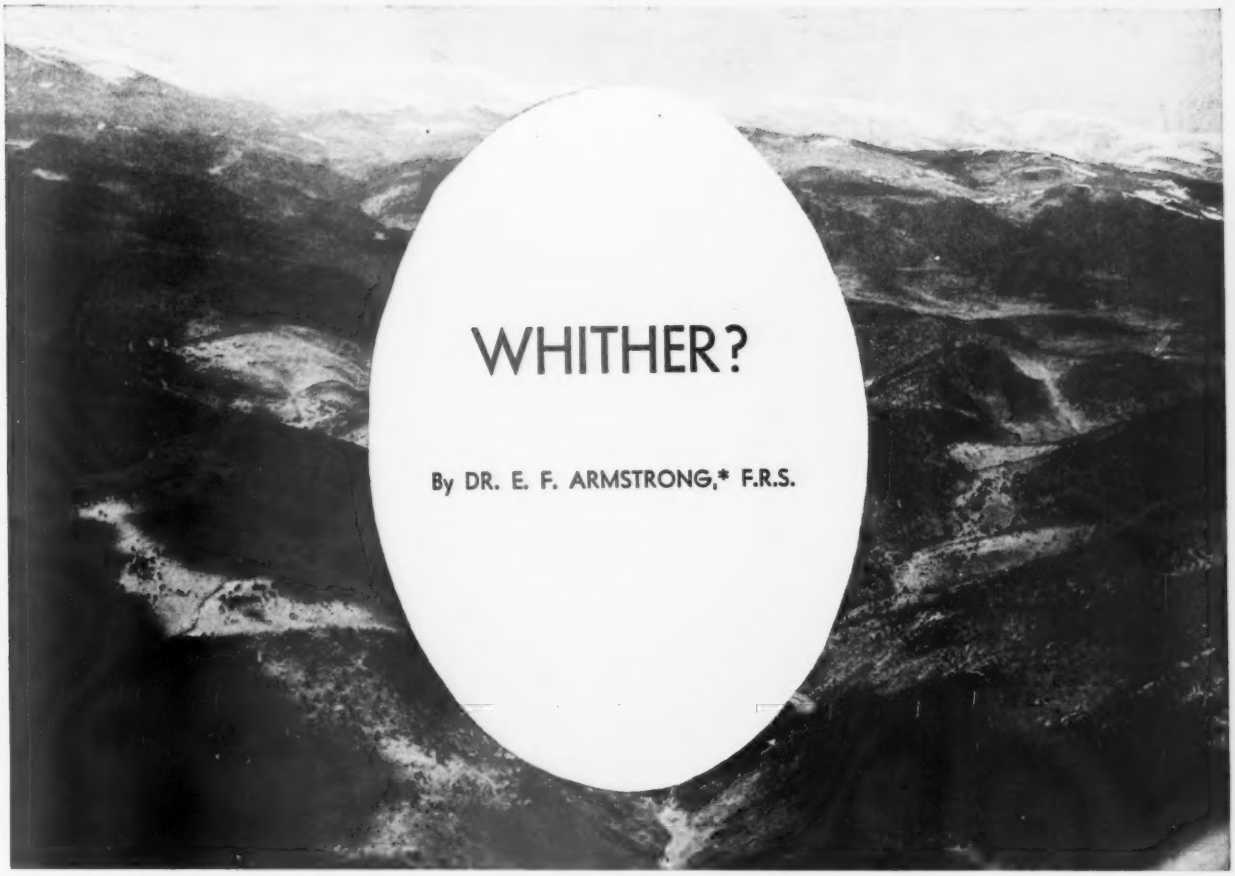
New Tax Publication

● A NEW report, entitled "The Taxing Power of the Federal and State Governments," has been completed by the staff of the Joint Committee on Internal Revenue Taxation. It deals with the limitations on the Federal and state taxing powers and development of the law as applied by the supreme court in actual cases. It provides a ready reference to decisions bearing on revenue legislation.



WHITHER?

By DR. E. F. ARMSTRONG,* F.R.S.

"Freedom alone he earns as well as life,
Who day by day must conquer them
anew."

IT IS not difficult to talk to a lay audience on the achievements of the chemist and of chemical industry during the past decade, but it becomes a hard task for a chemist to address an assemblage of experts unless he is fortunate enough to have a tale of successful, new and original work to unfold.

In default of such a tale, there are certain basic problems which affect us as citizens and as chemists, whatever be our nationality, which it can do no harm to ventilate at this meeting; for there is a need to put the house social more under considered control.

The Oxford Dictionary defines my title word as an archaic term and I therefore hold it appropriate for a citizen of the Old World talking to the workers of the New World. Your problems are the same as ours, though on a larger scale; you are less hampered by the past, and by your birth and nature are more adventurous.

Chemists, as a class, are chiefly concerned with tomorrow, seeking to perfect the existing, planning excursions into the new worlds. Like Ulysses, the scientist sees gleams of an untraveled world "whose margin fades forever and ever." The past only interests us so far as it represents recorded facts which can be used to investigate the future. To guide ourselves in the present we must observe and take lessons from the past. In chemical industry new methods are being sought for, either to give greater precision and more accurate control of reactions and processes, or to enable the manufacture of new substances on the large scale. In the laboratory, our ultimate task is to understand nature, and to this problem there are many ways of approach.

It is possible that purely academic research has reached its height at the moment; much of what is being published is of little value and is not worth the expenditure of either time or money given to it.

In the future, far more science will have to be put into the study of the countryside and less into the development of industry. Such application will very soon show up the evils of the get-rich-quick methods of farming. The politicians will continue to make play with the things the mass mind can comprehend, whilst the big problems that matter are left for the most part to find their own solution in the efflux of time. Science must see to it that the happy-go-lucky individualism of the past must give way to a well-thought-out system which will be to the greater good of a greater number.

The development of science has been based on the existence from time to time of men with intuition of unknown things, creative imagination, or the faculty of discovering hidden phenomena. Such men explored the physical universe and ascertained its secrets, whilst other men made practical application of these scientific discoveries for the benefit and the comfort of the public. Today the material world has been largely conquered whilst the extension of the conquest unceasingly absorbs the majority of scientific men. Technique has been the key that has opened the door to advance in all directions.

If we were to attempt to describe to a stranger from another planet all the benefits which have been recently conferred on the peoples of most nations leading to greater comfort, a higher

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standard of living, more recreation, rapid transport, and so much else besides, it would be justifiable to expect him to explain in how happy and contented a state must your world be!

And yet, as we know, the reverse is the fact, the increase in material comfort has brought unrest; by imposing leisure upon man, scientific civilization has brought him misfortune. It has, alas, proved too true that irresponsibility is harmful, that leisure engenders degeneration in the poor as well as in the rich.

Idleness, whether created by prosperity, by unemployment, or by mass production and modern machinery, is the problem of the age; on its solution depends, maybe, the future of the world.

There are many who blame the chemist and the engineer for the state of turmoil, saying that the rate of progress is too rapid, and even that it should be halted. This we know to be an impossibility from every point of view, though it is perhaps not sufficiently realized that the purpose of civilization is *the progress of man* and not the progress of science and machines.

This fact must form the foundation of our efforts to reconstruct the situation. Here, surely, is the opportunity of the chemist. As a profession, we are wont to complain, both in private and in public, that we have not received the recognition we merit. In point of fact, far too many of us are but hewers of wood and drawers of water, measurers and tap-turners, though adorned with a university degree; our life is too narrow, our ambitions are too limited.

It has been said that the scientist can never be a pioneer in the true sense of the word, largely because he is tied by the accepted standards of his profession. Surely many of us need no longer accept this as true. Having qualified as scientists, with powers of observation and the ability to reason, we can turn our energies to some of the major problems which beset the world, problems which are so obscured by political opportunism, personal cupidity, and intense nationalism that their real magnitude and gravity are largely misinterpreted.

Let us examine some of the world problems from the point of view of the chemist. The outstanding ones concern agriculture (which includes food), power, transport, and housing. Their solution must involve many disturbances of existing conditions and will bring with it the problem of the proper use of leisure; it is the emphasis of this fact which is the main purpose of this paper. We see in particular the need to introduce a greater share of human sympathy into commerce and industry.

A most important development of the day is the new science of food, which has already given a new meaning to the word malnutrition. In particular, it has brought the knowledge that food is the first of all the weapons of preventive medicine and shown that it must be the function of the agriculturist in the near future to grow complete foods and not mere market produce. Life is so complex that we have forgotten how entirely food is its foundation and mainstay. The need for purity in food and for legislation to enforce it was particularly recognized by that great pioneer in Washington, Harvey W. Wiley, and it is pleasing to make this tribute to his memory. Since his beginning, a large army of chemical and medical experts is continuously on the watch in all countries to prevent sophistication, but we have only recently learned that life depends upon the concurrent balanced interactions of a considerable number of material agents in the food, some of them substances directly derived from the soil, others formed in the plant, all indispensable in some as yet unknown way to health, and some of them required only in the most minute proportions.

A regular avalanche of investigators has descended on the subject of the vitamins since their first discovery by F. Gowland Hopkins, which has resulted in some instances in their isolation, identification and even synthesis.

Chemists alone are able to appreciate to the full the magnitude of the achievement, but it is not to this that I would draw attention. It is the implication of the discoveries on national policy which is so important. Here, surely, the chemist has an opportunity and a duty to go outside his ordinary sphere. Since the new discoveries, the way is now open to many complex chemical problems. One such will be what chemical substances in foods, if any, can give intelligence, courage and alertness to the inhabitants of a city? A trace of iodine may shift the balance from idiocy to sanity. Can we feed to produce nervous strength and mental agility? At present it is more than doubtful if chemical factors alone in the food are sufficient to achieve such ends, for we are biological and not physical entities. All that can be said is that certain chemical elements assume our racial and individual peculiarities; they become truly ourselves, whereas, other chemical substances only pass through the body.

Dr. E. F. Armstrong

In England, where today so much of the food is imported, these are some of the consequences of the new doctrine:

(1) In self-protection, she must produce all the food possible at home, the more so if she fails to maintain her prosperity as a manufacturer of finished goods in the export trade.
(2) Only the best sort of food should be produced.
(3) Since the essence of the value of vegetable food lies in its freshness, much of it will have to be grown at the doors of the cities.
(4) Certain areas will be found to be specially suited to produce quality food.
(5) The production of quality milk will have to be specially studied.
(6) This involves the consideration of what shall be fed to animals.
(7) Much of the existing agricultural practice will have to be changed; for example, dried young grass may take the place of hay.

The public will have to be educated in regard to the new food lore; in this respect, I believe the United States is in advance of Europe. Ignorance is due, in some respects, to lack of resources, and it is clear that improvement of nutrition must depend on the maintenance and improvement of the general level of income. When the farmer produces mainly the more costly protective foods, it should be possible to better the standard of agricultural wages. Apparently, in the past mineral fertilizers have been overworshipped and it is only gradually being realized how much harm is being done to the land by the virtual disappearance of farmyard manure—a factor to the debit side of the automobile account. Minerals alone, however well balanced, are not the equivalent of farmyard manure and it is essential to make some artificial product to replace it. Here the chemist is able to help, and the work particularly of Sir Albert Howard at Indore is pointing the way how to make use of decomposing cellulosic and similar waste: some day such products will be made on the largest scale, and, supplemented by suitable minerals, will give new heart to the soil to which it is added. We cannot afford any longer to waste organic material. We must have humus manures if we are to put quality into agricultural produce, especially into the table vegetables.

The drying of grass quickly by hot air instead of over many days by the uncertain rays of the sun is probably the first of a series of changes from the old order of farming. Hay used to be cut only once or twice a year, whereas the young grass may be cut three or four times a year. Such procedure must be exhausting to the soil, for it removes nitrogen, potash, and other constituents which have to be returned to it by the farmer. So far as the English experience goes, this method of growing grass is highly remunerative, for the product has a far higher feeding value, being richer in fat, sugars, and proteins, than ordinary hay, and the crop is claimed to be worth up to $100 an acre at present prices. Naturally, standard practice is not yet available, as information is being sought on the exact times of cutting, the nature of the herbage, the proportion of clover, and many other variables.

The rapid drying of grass on the farm involves a great deal more than the mere operation suggested by the words. New schemes of manuring and rotation of crops have to be worked out so that the land is not permanently under grass, but returns to cereals every few years. Permanent grass does not yield as much per acre as the same land farmed on a rotation system. It is claimed by the experts of the new procedure that if the area now devoted to permanent grass in England was converted to high-class, long-duration leaf a threefold increase in productivity could be anticipated. It is possible to keep a dryer continuously in operation for six months in the year on a farm with 250 acres of grass: the dried product is baled as it leaves the machine and its value assessed on its protein content.

The outstanding fact, however, is not the increased yield of grass per acre, but the fact that cows fed with it during the winter give milk of summer quality in regard to vitamin content, a result which has been attained in no other way.

There is strong reason to believe that the findings of biochemistry and medicine will afford conclusive evidence that freshness in food is of paramount importance to a nation so that there will be a national outcry, both for the absolute maximum of home production and for production of vegetables contiguous to the great cities. The more perishable a product, the nearer it should be grown to the actual consumer, for the whole excellence of soft fruit and vegetables turns on their freshness.

The importance of eating green leaf vegetables so as to secure a proper proportion of vitamins is now public knowledge, and good prices are paid to secure the greens. What is alarming is the rate at which the vitamins disappear with age, so that green vegetables exposed for sale in the East End of London three or four days after picking are found to be almost completely devoid of vitamin. It would appear desirable to have such greens available for sale and consumption the day they are picked, which necessarily involves their being grown in close proximity to the city on land on which perhaps the speculative builder has cast his eye.

The industrialized nations are fast losing touch with nature and with the land. To be urban-minded means to be herd-minded, and the city dweller is ceasing to think for himself and is losing personality. The countryman has an intimacy with and responsibility for the land which is innate: this feeling is well brought out in a play, "Desire Under the Elms," by Eugene O'Neill. Only the few can now delight in the smallest detail of nature's most wayward fancies.

Many problems are in process of being solved in connection with the transport of food, which have enabled meat and soft and other fruits to be brought regularly into British and other ports from the ends of the world. Gas storage, involving preservation in an atmosphere with a regulated content of carbon dioxide, is a new phase in the solution of food storage problems which is likely to prove of great utility, whilst processes of artificial ripening, effected by traces of ethylene and other gases, have become established in practice. In America, transport by air is playing a part in bringing fresh products from the favored South and West to your luxury markets, whilst the discovery of the uses of solid carbon dioxide—dry ice—has made a new technique of food transport and preservation possible.

One essentially scientific problem is the answer to the more difficult question which is the most important; the land, the products of the land, or the tillers of the land. In reality, the answer must be the land, for its condition and its maintenance in good health matters far more over a lengthy period of years than what it may have on it. In England today the products are regarded as the most important, under the policy of the Minister of Agriculture, because of the need of increasing home production as an insurance against war. Elsewhere, the farmer, thanks to his political influence as a voter, is regarded as more important than the land or its products. This is an outstanding example of the neglect of scientific principles: the consequences of the errors do not appear immediately, but when they do it is often too late to obviate them. I will do no more than refer to your immediate drought problems in America and to the system of premiums paid for not growing crops.

Attention to the land has this advantage that it gives a flexibility to farming so that in time of need additional crops can be raised at short notice.

Low-priced power is an outstanding need of our civilization; the methods of producing it vary according to the natural resources of the various countries. Canada has unlimited water power, Britain has to depend on coal, the United States has both, in addition to natural gas and oil.

The cost of water power has been greatly reduced since it has been worked out how to use the same water through a series of turbines at successive lower levels, thus spreading the initial cost of collecting the headwaters over a larger output. The water power installations are usually remote from the centers where the power is used, so that a transmission cost also enters into the economic calculations as well as transmission losses. It is a task for the technician to reduce these, but one of the items is the basic cost of copper. It is the intention of copper producers the world over to increase the price of copper so as to make the industry remunerative. Hence, as happens throughout industry, there is conflict between two powerful interests, and the solution may lie either in a reduction in the cost of production of copper, or the discovery of a substitute for it, such as iron coated with aluminum for the transmission cable.

The amazing development in transport is linked to three lines of progress: (1) the discovery of the internal combustion engine and its progress, together with that of the rest of the car, to the present state of efficiency which enables anyone to drive an automobile; (2) the building up of the great oil industry to give gasoline and lubricating oils at a low cost so that the cost of transport by car for four people is less than that by rail; (3) the planning and development of arterial roads.

The chemist has ably played his part in all the developments under the two former headings, the story being too well known to need recapitulation, and he will do so in regard to the technical side of making suitable hard-wearing, non-skidding roads. The road problem is very far-reaching in its implications: it differs somewhat in the different countries. In America, for example, you can construct long, straight roads over flat country without being hampered at every turn by vested interests and existing house property.

In Britain, such problems are much to the front: only twice before in our history have we made roads. Once when the Romans drove them straight across country, preferably along the top of the ridges for military purposes. Again in the days of coaching and posting, when the turnpikes came into existence. But when the railway came the roads were neglected again, and with the advent of motoring there is all to do: so far, the new cars are appearing at a faster rate than the roads to carry them.

The social consequences of the advent of the private car and the public bus have been enormous. There are now no longer any remote villages, the London morning paper can be on the breakfast table of almost every home in the land. Many of the distinctions between the townsman and the countryman have disappeared, though their occupations still make them of two different types. There is no longer any real reserve of caution, of slowness to act, in the country of England; on stirring questions all are swayed alike and since the new transport facilities have destroyed distance, the villager seeks and enjoys the amusements of the towns.

There he finds the cinema, another leveller of man, bringing the same messages to the whole world. The films in general are on a low level; they appeal to man's baser traits rather than to his better. Their propaganda value is enormous and likely to be made use of; the news reels serve to make everyone immediately conscious of what is happening everywhere.

Even more far-reaching in its influence on the peoples is the radio, which enters into every home and is today the finest means of political approach—a whole nation can be appealed to and instructed in a few minutes.

Both cinema and radio are triumphant witnesses of scientific progress; the fact should be more widely advertised by both.

Certain abnormal factors are having their effect on the development of industry in nearly every land. One of these,

(*Concluded on page* 63)

Wheels of Government

As viewed by A. W. Dickinson of the American Mining Congress

AS THE cruiser bearing the President on his good-will visit to the Argentine plowed the blue waters of the Atlantic, the early part of December was given over to planning and preparation for the coming session of the Seventy-fifth Congress.

In the legislative planning is found another work-relief measure, including a $500,000,000 appropriation for the period from January to June, 1937. Further measures include the extension of executive power over the value of the dollar and the maintenance of the stabilization fund; extension of executive power to negotiate trade agreements; a possible revision of the undistributed earnings tax to give relief to debt-burdened corporations, and some form of legislation to permit of a business stabilization such as was unsuccessfully sought in the NIRA.

Again the bituminous coal industry seems to be the focal point in the effort to bring forth legislation designed to stabilize industry. During the month two groups of Appalachian operators met in New York. One group consisted in the main of the men who advocated the enactment of the Guffey Coal Bill of last spring. The other group was made up of the men who so vigorously and successfully opposed the enactment of that bill. As the story goes the proponent group after much careful consideration decided that it would be thoroughly impracticable to attempt the enactment of legislation against what would most certainly be the determined opposition of those who had formerly opposed such legislation. A conference was sought and arranged between representative committees of the two groups and as the result of this conference attorneys representing the Northern and Southern Appalachian Bituminous Coal Producers met on the 29th of December at White Sulphur Springs, W. Va., to draft the desires of their clients into a workable bill.

Coincident with the meeting at White Sulphur Springs came the announcement by the United Mine Workers of America that the Union will be agreeable to stabilization legislation for the bituminous coal industry providing that it will permit the maintenance of prices for bituminous coal which will protect the wages of the mine workers. Many observers see in this situation a parallel to that which exists in the railroad industry, wherein matters of hours, wages and working conditions are handled by management and the representatives of labor entirely apart from the stabilization of railroad business enterprise. The thought is even expressed that these two industries, railroading and bituminous coal mining, may be pointing out the way, blazing a trail, to the long-sought remedy for business and industrial problems. Observers believe that the bill on which drafting began at White Sulphur will contain provisions for large sales agencies, similar to Appalachian Coals, Inc., for fair trade practices and for open price filing, all subject to the guidance of the Federal Trade Commission. As to labor provisions, there may be simply the recognition of collective bargaining.

During the month the Social Security Board has carried on with the registrations under the old-age assistance feature of the act. The registrations are reported to have reached approximately 22,000,000 of the 26,000,000 workers. The Board has been deluged with inquiries pertaining to the mechanics of operation of the act and as is always the case with a new organization it is difficult to secure decisions and rulings in a short time. One special ruling of interest has been made under Article 206 of Regulations 91 wherein provision is made that each employe must be given a written statement of each tax deduction from his wages. In response to an inquiry by the American Mining Congress as to what would constitute a proper written statement to an employe the Bureau of Internal Revenue said: "That a statement *printed on the face of a check form or pay envelope* showing the deduction on account of the tax imposed by Section 801 (Title VIII) of the Social Security Act as distinguished from any other deductions, will constitute compliance with the provisions of Article 206 of Regulation 91."

The Department of Labor activities in connection with

silicosis have been marked in December by meetings of the several committees appointed to study the silicosis problem. On December 16 a jont meeting of the committees was held at which progress reports were made to Secretary Perkins. At that time February 3, 1937, was set for the next meeting of the National Silicosis Conference, to which a large number of representatives of industries having dust control problems will be invited. Invitations will also include representatives of labor, insurance, medical and state health organizations. The Department of Labor has indicated that the information developed in the reports of the various committees will be made available to the legislatures of the states for use in connection with bills covering liability for occupational diseases.

The Interstate Commerce Commission ruled on the 19th of December that the emergency surcharge under which the railroads are collecting in excess of $100,000,000 annually over and above the normal rates should not be extended beyond December 31, 1936. This is of pointed interest to the mineral industries inasmuch as they furnish considerably more than one-half of the revenue freight tonnage hauled by American railroads. Among the minerals affected are: coal, coke, iron ore, petroleum, copper, lead, zinc, aluminum, cement, stone, phosphate rock, sulphur, salt, borate rock, asphalt, gravel, sand, lime, barytes, clays, silica, pyrites, fluorspar, feldspar, slate, talc, and others. Chairman Charles F. Hosford, Jr., of the National Bituminous Coal Commission, stated at the hearing that excessive freight rates have been one of the major causes of the depression in the bituminous coal industry. He declared that any further continuance of the emergency rates will result in irreparable injury to the coal industry and will permanently harm the railroads themselves. He further said: "I submit that if the policy of Congress is to be carried out and if this major natural resource industry is to be stabilized and restored to a reasonable degree of prosperity, the general level of coal freight rates must be reduced so as to conform more closely to the mine price and to the actual value of coal to the consumer."

On December 23, the Securities and Exchange Commission promulgated the new form, A-O-1, for the registration of the securities of mining corporations organized within two years to engage in the exploitation of mineral deposits, other than oil or gas. Accompanying the form is an instruction book containing detail as to the filing of the form and the accompanying exhibits. The final draft of this form and instruction book is the result of 18 months and even more of work on the part of the Rules and Regulations Section of the Securities and Exchange Commission, the mining engineers for the Commission, and many mining men, engineers, accountants and others who have sought to simplify the structure and to minimize the task which the form presents to those engaged in the development of mineral enterprises. The members and the staff of the American Mining Congress have cooperated with the Securities and Exchange Commission and its staff in this work. In addition to the work done at the Metal Mining Convention in Denver late in September, where Chairman Landis, of the Commission, addressed the convention, meetings were held in Denver on November 30 and December 7; in Salt Lake City on December 1 and 2; in Spokane, Wash., at the convention of the Northwest Mining Association on December 3, 4 and 5. All of this work has been supplemented by many conferences in Washington. The principal changes in the final form are found in the definition of the word "promoter" and in the statement of the value of a property turned in for securities, under Exhibit K as set forth in the instruction book. The term "promoter" is defined to include:

(1) Any person or persons taking initiative in founding and organizing the enterprise;

(2) Any person who in consideration of services has received or is to receive 10 percent or more of any class of securities of the registrant;

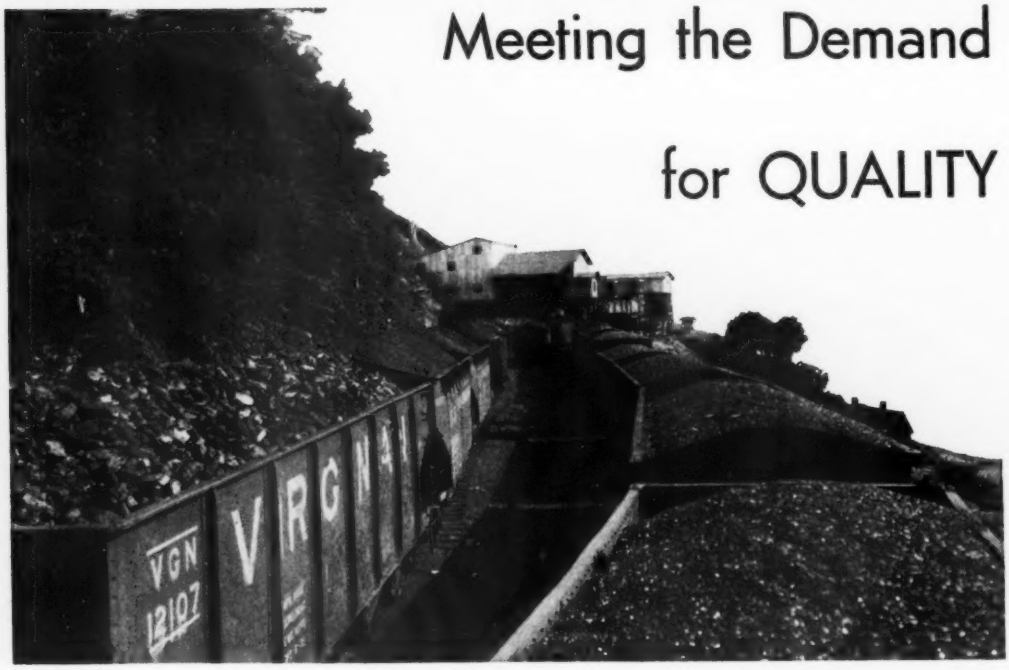
(3) Any person who in consideration of property has received or is to receive 10 percent or more of any class of securities of the registrant, unless such person has not taken a significant part in founding and organizing the enterprise;

(4) Any person for whom any promoter is acting in a representative capacity with respect to the registrant.

Under Exhibit K, it is provided that there shall be filed a statement signed by the majority of the Board of Directors setting forth the value in dollars of property turned in for securities. The instruction book now states "there shall also be stated the value in dollars of such property if sold for money in an arm's-length transaction, other than a forced sale, made within a reasonable time after the date of issuance of such securities. If the property has no such value, so state. If the property has such value but the amount thereof is impracticable of determination, a statement may be made to that effect; *in such case*

(*Concluded on page* 63)

Meeting the Demand for QUALITY COALS



Presented by

W. J. Jenkins, Pres., The Consolidated Coal Co.

Peter F. Loftus, Consulting Engineer

W. H. Lesser, James H. Pierce & Company

John A. Garcia, Mining Engineer

John C. Cosgrove, Pres., West Virginia Coal & Coke Co.

Marc G. Bluth, Executive Secretary, Committee of Ten, Coal & Heating Industries

Barton R. Gebhart, Vice Pres., Chicago, Wilmington & Franklin Coal Co.

C. V. Barrow, Chemist, DeBardeleben Coal Corporation

R. H. Sawens, Solvay Process Company

Ellsworth H. Shriver, Raleigh Coal & Coke Co.

Meeting the Demand for QUALITY COALS

By W. J. Jenkins*

IT IS perhaps trite to say that gone are the days when coal was merely coal and coal was king. A backward glance will not be amiss. Following the collapse of the stupendous demand for coal during the World War, there set in almost immediately what we knew in later years was a devastating "process of elimination" among coal producers. Former easy-going, more or less slipshod methods, both of production and distribution, did not suffice. Overproduction and shrinking markets, increased use of competing fuels and sources of power, naturally brought forth latent desires for new sales arguments, rather blundering efforts to catch the elusive order through the introduction of new sizes, oversizing, and other fancy modifications of a somewhat purposeless nature.

This period from 1921 to about 1928 might, in a homely sense, be called the awkward age of the modern coal industry—we were suffering from growing pains, without really knowing what it was all about. We did know definitely that tonnages were shrinking, that prices were declining, and that the road was getting rougher. Naturally, the weaker producing units soon folded up, those in the middle stratum developed gray hairs and worry lines, while the larger, better-financed concerns found themselves not only forced to draw upon their reserves but to devote their energies and brains to the preservation of their commercial existence against the storms that beat upon them, both from within and from without.

Before long, coal operators began to stop imitating each other in the purposeless activities mentioned, ceased following the crowd, so to speak, and very properly began to look inwardly, to analyze their individual problems and to develop ways to make their coals attractive, efficient, and entitled to a place in the competitive markets. This individualizing of the problems of production and preparation, the elimination of ash, sulphur, impurities, etc., started the industry off on the right track, although

* President, The Consolidated Coal Co.

again accelerating the process of elimination, the struggle for existence.

Mechanization started in earnest, preparation plants were rebuilt, enlarged or redesigned to bring about not merely lower costs but also improved quality, elimination of impurities, more uniform sizing, and to meet the more discriminating demand with a better coal. Coal consumers of all classes, usually beset with keen-edged competition within their own industry, learned to their surprise that considerable savings were possible in the boiler room or power plant—they began to think in terms of cost per thousand pounds of steam, of pounds of water evaporated per pound of coal, to meter their plant performances and to chart the way to increased efficiency and lower costs. Harassed chief engineers, long expected to produce ample steam or power from dilapidated, worn-out plants, now found themselves able to tap funds formerly rigorously reserved for improvements in the directors' rooms or enlargements in advertising broadsides. Old-time engineers, graduates of the fireman's shovel in many instances, found themselves replaced by younger, keen-eyed men with technical training, under orders to find new, better, and less costly methods of making the wheels go around.

Then along came the small industrial and household stokers! Talk of automatic coal heat was heard abroad in the land and our industry was given a great forward impetus—we are still hurrying, mentally and physically, to catch up. Stoker installations are breaking records almost daily. A retail coal merchant in a small town, entirely new in selling stokers, installed 26 stokers since midsummer. An exclusive stoker agency, maintained jointly by leading coal dealers in the Twin Cities, made 140 installations in the first three months of its existence.

Progressively minded coal operators are intensively studying proper sizing, preparation, market trends and market needs, with better trained engineering and merchandising forces. Dedusting and washing plants have been, and will continue to be, installed by enterprising operators in fields not blessed with premium coals, and operators not so equipped will drop behind. Treatment with oil and other dust-allaying agents are rapidly progressing out of the experimental stage. "Clean coal" is the cry on every hand. Specific coals are being produced for specific equipment and uses. Possibly more real progress in this respect has been made during the last five years than in the preceding 50 years.

All in all, it is a record of which the coal industry may be proud, a record that spells new life, and an unassailable position in the economic picture, and one that will eventually lead us to the long-sought goal of reasonable returns on invested capital.

Pertinent Factors Influencing Trend of BITUMINOUS Coal Industry

By Peter F. Loftus*

AT THE request of the American Mining Congress to set forth briefly my views of the trend of the bituminous coal industry in the United States of America, I have endeavored to correlate and analyze, and present herein, certain pertinent data concerning the relation which exists between bituminous coal production and industrial activity in the United States; and the specific relations which exist between bituminous coal production and the activities of the electrical industry, the steel industry, and the railroads, which three major divisions of industrial activity have, to the present time, taken practically 50 percent of the total bituminous production.

The 11 curves of the accompanying graph, plotted as they are on logarithmic ordinates, portray the truly relative and proportionate trends of bituminous coal production in relation to general industrial activity, and the specific activities of the electrical industry, the steel industry, and the railroads.

An analysis of the industrial activity curve "A" will disclose a consistent rise, more than doubling between the years 1905 and 1929. Although curve "A" defines a pronounced increase in industrial

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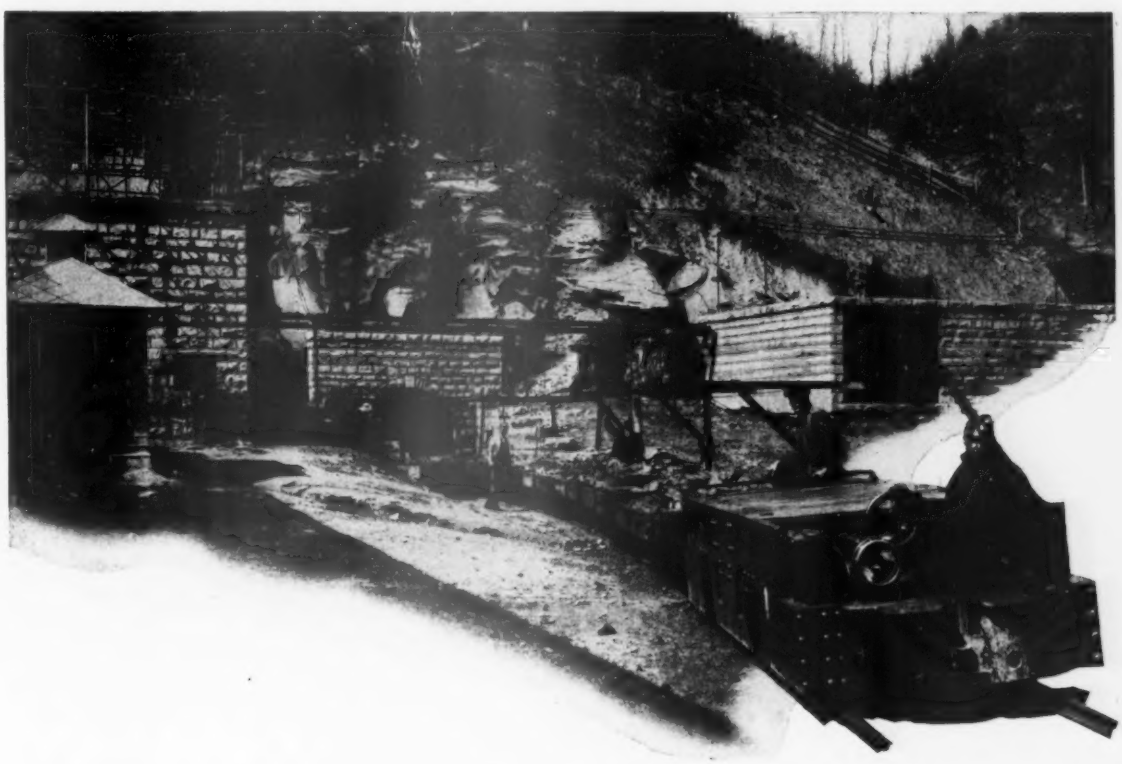
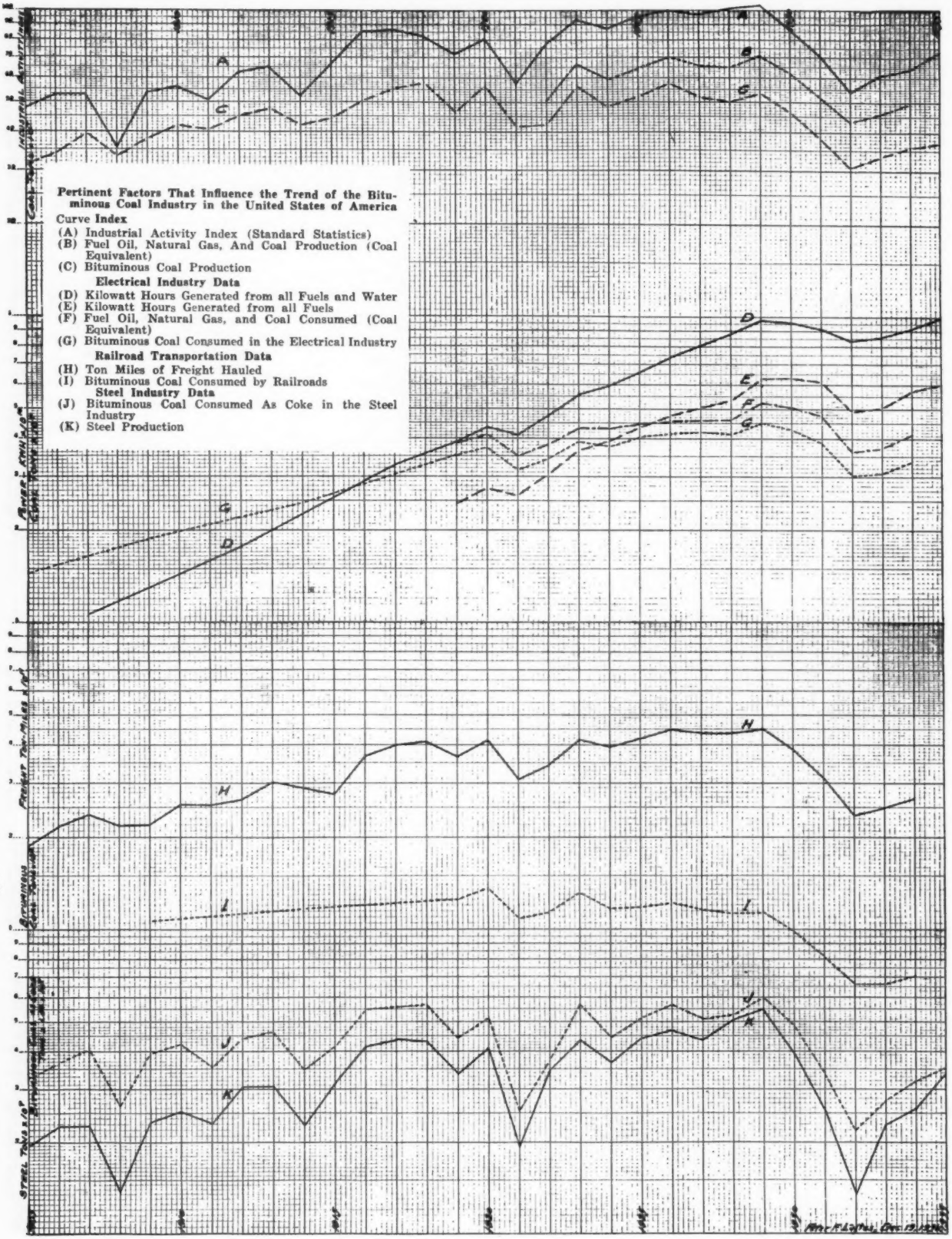



Pertinent Factors That Influence the Trend of the Bituminous Coal Industry in the United States of America
Curve Index
(A) Industrial Activity Index (Standard Statistics)
(B) Fuel Oil, Natural Gas, And Coal Production (Coal Equivalent)
(C) Bituminous Coal Production
Electrical Industry Data
(D) Kilowatt Hours Generated from all Fuels and Water
(E) Kilowatt Hours Generated from all Fuels
(F) Fuel Oil, Natural Gas, and Coal Consumed (Coal Equivalent)
(G) Bituminous Coal Consumed in the Electrical Industry
Railroad Transportation Data
(H) Ton Miles of Freight Hauled
(I) Bituminous Coal Consumed by Railroads
Steel Industry Data
(J) Bituminous Coal Consumed As Coke in the Steel Industry
(K) Steel Production
A
B
C
D
E
F
G
H
I
J
K

activity during the years of the World War, and a decided decrease during the years of the recent depression, it may be reasonably assumed that a consistent rise in industrial activity will continue into the future.

An inspection of curves "A" and "C" discloses that, although the bituminous coal production curve follows the general pattern of the industrial activity curve, coal production reached its all-time peak in 1918, whereas industrial activity did not reach its peak until 1929. Bituminous coal production since 1918, however, has not been keeping pace with industrial activity, and has shown a definitely declining tendency.

During the year 1918, the peak year of bituminous coal production, when 579,386,000 tons of coal were produced, the industrial activity index was 82.2. In 1929, however, when industrial activity had reached an all-time high index of 108.1, bituminous coal production had decreased to 534,989,000 tons, indicating a production decline of 7.66 percent, with a corresponding increase of 31.5 percent in industrial activity as measured from a 1926 industrial activity base index of 100.

An analysis of the data presented in curves "B" and "E" will immediately disclose the serious encroachment of fuel oil and natural gas into the markets of the bituminous coal industry.

In 1922, when 422,268,000 tons of bituminous coal were produced, the combined fuel oil and natural gas production represented the equivalent production of 82,900,000 tons of bituminous coal; but in 1934, when the bituminous industry's production had decreased to 358,395,000 tons, a decline of 15.1 percent, the combined fuel oil and natural gas production had increased to an equivalent bituminous coal production of 136,900,000 tons—an increase of 65.1 percent, in the face of 15.1 percent decrease in bituminous coal production.

In 1919 the electrical industry used, in fuel oil and natural gas, the coal equivalent to 3,780,000 tons, or 10.8 percent of the industry's total coal consumption; in 1929, however, its use of fuel oil and natural gas had increased to the coal equivalent of 7,637,000 tons, or 17.0 percent of the industry's total coal consumption, an increase of 102.0 percent in the use of fuel oil and natural gas, as compared with an increase of only 28.0 percent in the use of bituminous coal.

A graphic analysis of certain pertinent features of the bituminous industry's position in relation to the electrical industry is disclosed in curves "D", "E", "F", and "G."

The electrical industry in 1919 generated, from all power sources, 38,921 million kilowatt hours; and in 1929 this generation had increased to 97,352 million, an increase of 150.1 percent. During this period, however, the consumption of bituminous coal had only increased from 35,100,000 tons to 44,937,000 tons, an increase of 28.0 percent. During the same period the generation of electrical energy from water power had decreased from 37.5 per cent in 1919, to 35.6 percent in 1929; and, although the electrical industry had increased by 102.0 percent its use of fuel oil and natural gas, the primary reason for the failure of bituminous coal consumption to keep pace with the increase in the electrical industry's generation of power lies in the increased efficiency obtained by the electrical industry in its utilization of coal. In 1919, 3.2 pounds of fuel were consumed per kilowatt hour generated, whereas in 1929 only 1.69 pounds were consumed, determining an improved efficiency in fuel utilization of 47.2 percent.

An inspection of curves "H" and "I", showing the relation of total bituminous coal consumed in railroad transportation, in both passenger and freight service to the total ton miles of freight hauled, discloses that in 1909 for every ton of bituminous coal consumed 2,064 ton miles of freight were hauled, whereas in 1929 for every ton of bituminous coal consumed 3,953 ton miles of freight were hauled, disclosing a decrease in the use of bituminous coal consumed of 47.8 percent per ton mile of freight hauled.

An inspection of curves "J" and "K," showing the relation of total bituminous coal consumed as coke in the steel industry per ton of steel produced, discloses that in 1909, 2.599 tons of coal produced one ton of steel; whereas in 1929, 1.682 tons of coal produced one ton of steel, a reduction of 35.3 percent in the coal consumed as coke per ton of steel produced.

The scope of this article permits only a broad interpretation of the data presented in the accompanying graph, and does not permit any comprehensive expression of views on future trends of the bituminous industry.

Summarizing the pertinent factors presented herein discloses that the bituminous coal industry has shown, since 1918, a definitely declining tendency, and that it has not kept pace with industrial activity; due, in the instance of the three divisions of industrial activity herein analyzed, to the encroachment of fuel oil and natural gas into the markets of the bituminous industry, and to increased efficiency in the utilization of coal.

Since bituminous coal production follows the general pattern of industrial activity, and since both bituminous coal production and industrial activity have been slowly, although consistently, improving since 1932, the bituminous industry can look forward to a continuation of increasing production, at least into the immediate future.

A careful analysis of trends, as reflected in the accompanying graph, leads me to believe that the bituminous coal industry, to again realize the all-time production peak that was reached in 1918, must evolve an economically sound method of checking and reducing the encroachment, into its markets, of fuel oil and natural gas.

Future Trends in the ANTHRACITE Industry

By W. H. Lesser*

EVER since Judge Fell, in 1808, demonstrated that anthracite would burn, there has been a definite trend toward a quality fuel. Sizes, not previously cleaned, are now being marketed with an ash content approaching the inherent ash in a piece of pure coal. The early crude and uncontrolled cleaning processes have been replaced by a cleaning technique developed during years of experimentation and research. Many methods of cleaning anthracite have been tried and discarded for those now found in the modern anthracite breaker.

During the lean years of the depression, a period of radical changes in every industrial activity, the anthracite industry has been alert to the fact that changes in its cleaning processes were necessary if it was to maintain its position as a producer of an efficient and economical fuel. Breakers with a capacity of 1,250 tons per hour of clean coal, in nine sizes, obtained from a run-of-mine containing 30 percent of refuse, are tangible evidences of the industry's desire to meet a demand from a public that wants more heat per dollar spent. More stringent preparation standards have been met at such a sacrifice in monetary realization that one must pause and consider when the limit in quality coal will be reached. Coal with a pleasing appearance and a cubical fracture must be shipped, notwithstanding the loss occasioned by breaking poor-looking and flat coal into the smaller sizes.

The rapid depletion of the clean beds of coal, and the necessity of mining the poorer beds, have added additional cleaning problems, but the modern breaker has proved its ability to clean any product that comes from the mine without an excessive loss of merchantable coal to the refuse bank.

The preparation of anthracite consists of three major processes; crushing, sizing, and the elimination of impurities.

When anthracite was first mined, the coal prepared for market was practically only the large lumps, and they were reduced in size by sledge hammers. Power-driven rolls with alloy-steel teeth of various shapes and sizes now do the crushing necessary to properly prepare the tonnage. The crushing problem involves the reduction in size of about 20,000,000 tons of coal per year, with a minimum production of fines; and each year the tonnage is increasing, because more of the larger sizes, more poor-looking coal, and more flat coal must be broken into the smaller sizes. This trend makes good roll practice imperative, if a maximum percentage of prepared sizes is to be obtained.

* James H. Pierce & Co.

Last year there were 45,000,000 tons of anthracite shipped, divided among nine sizes, the largest, broken coal, through 4½-in. and over 3¼-in., and one of the smallest, No. 4 buckwheat, through 3/32-in. and over 3/64-in. Shakers, classifiers, and thickeners solve the sizing problem, which becomes more important as the use of the small sizes in stokers increases.

That the industry is attempting to keep pace with the ever-increasing demand for quality coal is shown by the many different cleaning processes in use. There is perhaps no system applicable to the cleaning problem existing in the anthracite industry but that it has been adopted or discarded. Beginning with the hand-pickers, and they are still necessary in many breakers, processes involving the following general cleaning principles have been tried or are now used: jigs, high-density jigs, mechanical pickers, flat pickers, concentrator tables, oil flotation, sand flotation, settling in an upward current of water, hindered settling in an upward current of water, settling in a flowing stream of water, settling in an upward water current of a variable velocity, and separation in a high-density liquid. A study of these processes and a glance into a modern breaker will surely convince those interested in quality coal that the industry has overlooked no process having the slightest possibility of improving the preparation methods.

A survey of the present anthracite preparation standards and those of 25 years ago shows a reduction in the allowable percentage of slate in egg, stove, and chestnut of 25, 50, and 40 percent, respectively. Steam sizes then contained as high as 25 percent ash, and now the same sizes are shipped with a 12 percent ash content or less. Losses of merchantable coal to the refuse banks are smaller at the present time than ever. Accomplishments such as these, in the face of a poorer product from the mines, justify the many crushing, sizing, and cleaning processes found in the breakers.

The demand for quality coal has been met during the past, but not without its price. Through the reduction of the broken and egg tonnage by crushing and the regrinding of flat and poor-looking coal, there has been a gradual but consistent falling off in the percentage of prepared sizes (chestnut and over). Since 1911 the prepared sizes have shown a reduction of 9.5 percent of the then existing value of 62 percent, and as the realization on these sizes is depended upon to carry the costs, it is evident quality coal has its price.

If what has been done, and what is being done now, can be used as a yardstick for the future demands, then the anthracite-consuming public need have no fear of the producer's ability to supply it with an efficient and economical fuel. At the present time the public's demand from the anthracite industry is heat, automatically controlled, obtained from the small sizes, and burned in stokers, or "automatic heat." The answer to this demand is organized effort on the part of the producer, retailer, and equipment manufacturer. To obtain this three-point cooperation, Anthracite Industries, Inc., has recently been launched. This organization plans "to promote the greater use of anthracite," and it has already established 17 zones or territories where field men will cooperate with coal dealers, architects, heating contractors, equipment distributors, and the consumer. The coal dealer will be shown how to sell heat, and selling heat means more than selling coal; it means selling equipment and intelligent service.

There is a special size of anthracite for coal-burning equipment, beginning with the fireplace and ending with the complete automatic heat and air-conditioning unit. Only a quality fuel can support the intensive plan just launched to sell more anthracite, and that product the engineers in the industry are capable of producing.

Research in anthracite has been ably conducted by the research laboratory of the Anthracite Institute. It has developed several valuable units for burning anthracite and disseminated much information regarding the relation of anthracite and competitive fuels. The Institute's facilities for testing the design of equipment to burn anthracite is so well known that practically no device is marketed without first obtaining the approval stamp of the Institute laboratory. Some work has been done by the laboratory regarding the use of coal as a nonfuel, and it has resulted in small-sized anthracite being used in water filtration beds. Future research may extend coal into metallurgical processes, or into industries where its nonfuel characteristics can be utilized.

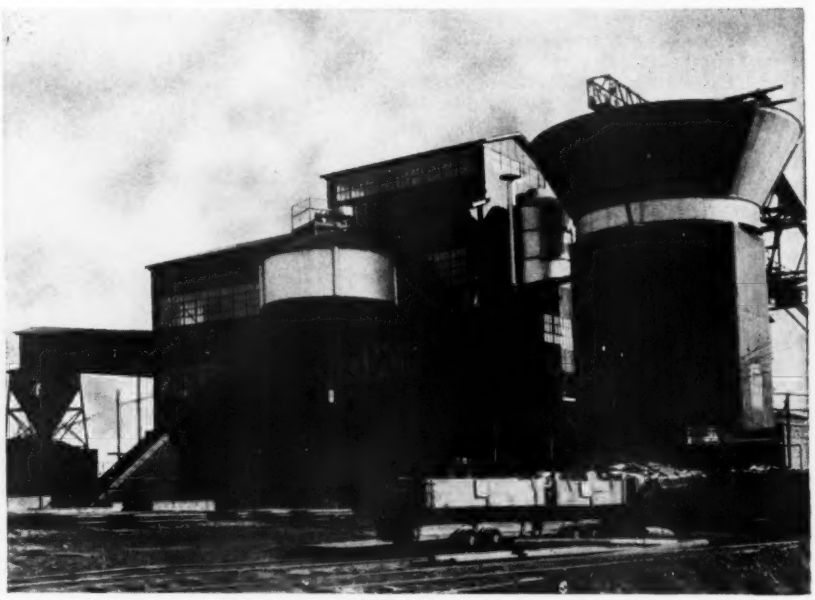
Research should not be limited only to the technology of coal; there are many other phases of the anthracite industry where research and study will result in helpful developments. Problems such as sales promotion plans, dealer service, sale of coal through pools of different grades, limitation of production to suit the demand, consumer's cooperatives, the reduction of coal brokers and retailers, training of salesmen, freight rates, coal trucking, dealer's profits, and reciprocity projects all are amenable to study and research.

With the advent of the automatic stoker, burning small sizes, the retail coal dealer was faced with the problem of unloading frozen coal during the winter months. His demand for a solution of the problem resulted in spraying the coal at the loading point with a liquid to prevent freezing while in transit. Another treatment now available will reduce the dust so objectionable to the modern housewife.

A demand for anthracite in bags developed during the recent years, and facilities are now available to meet it. One company bags about 50,000 tons annually, and it is considered a successful undertaking, both from a financial and sales-promotion viewpoint.

Many industries have deemed it necessary to trade-mark their products. The idea has extended to the coal industry, and some coals are now sprayed with a distinctive color to distinguish them from others. Another method of trade-marking coal consists in mixing paper discs with the coal as it is being loaded into the car. The discs have printed on them the necessary identifying information.

The future of anthracite should be encouraging. Recent estimates show 5,000,000 homes are prospects for automatic heat. Between 300,000 and 400,000 new homes are annually required to house the new population, and no doubt



Cleaning Plant, Peabody Coal Co.

a similar number should be remodeled. Residential building contracts in 37 states are greater for this type of construction than during the past five years. Developments such as those backed by the Federal Housing Administration afford the anthracite industry an opportunity to get its share of the new heating business. To get and keep its share of the present and future heating business will require a quality fuel which the anthracite operators will be prepared to furnish.

As a competitor, oil is now formidable, but as time passes and the supply becomes less, oil research will discover new products which will make it uneconomical to use oil for home-heating purposes.

The problem of distribution, as in all industries, is the most difficult to solve. Sales prices are not uniform, competition is keen, trucked coal and "bootleg" or stolen coal all disturb the sales situation. Cooperative agencies are studying this important phase of the industry, and encouraging results are expected.

Mechanical stoker sales are increasing. At the end of a 10-month period of this year, the total stoker sales, reported by 108 manufacturers, amounted to 70,539 units, an increase of 79.5 percent over the same period of last year, and an increase of 210 percent over the January-November period of 1934. The cost of stokers, no doubt, can be reduced if they were made in a few plants, and assembled on conveyors, similar to the automobile. Mass production usually reduces unit costs. Due to this great increase in use of stokers, the evident trend is towards the production of more small sizes with an accompanying lower realization. There will be combustion problems to be solved that do not exist in the hand-fired furnace, and studies will be necessary for their ultimate solution.

Quality coal is an important element in the program to increase the sale of anthracite, but without the cooperation of the producer, equipment maker, retailer and consumer, little progress will result. A mutual understanding and a constructive program among the producers themselves, and a similar understanding among those bodies interested in the distribution of the coal, will help the industry regain the enviable position it held during past years. I have faith in the men and agencies working on the problems of the industry, and have every reason to believe success will crown their efforts.

COAL Is Not Coming Back—It's Back

By John A. Garcia*

I HAVE more confidence in the coal mining industry today than at any time during the 30 odd years I have served the industry. All of the talk about over-production of bituminous coal in the United States is mainly during periods of depression and is seasonal, but in the main, the indications are that the demand is rapidly approaching the supply so that if and when, we learn to spread the output more or less evenly, by storage, the two main elements in our coal problem will be a long way towards solution.

The indisputable fact that mining properties and operations have been rapidly drifting during the last generation into the hands of strong corporations and individuals, well financed and well organized in the operating, engineering and sales departments, is of itself, evidence of the trend of the times and I am confident that this will be more marked in the future than in the past. This situation obtains in practically all the coal mining countries in the world, and it is inconceivable that we shall not continue along this line in America. The reasons today are obvious. In the first place, the initial cost of constructing a modern coal mine is beyond the reach of the average coal operator of the past, and requires today a financing program scrutinized and approved by independent engineers and bankers under the new rigid laws and rules of the Federal Government. In the second place, the conduct of operations, both stripping and underground, requires the use of the best trained men in almost every line of human activity, and the economical extraction or winning of coal is now almost a science, if not an art. Third, the combustion engineer enters the picture and with improved methods of burning coal the mining plant must be equipped to satisfy his demands which mean essentially, high class preparation.

The above factors eliminate the snow bird, the bootlegger and the poor fellows who unfortunately are not financially equipped, though otherwise capable to produce coal. The mines of the future will certainly be mechanized, top and bottom; the mining system will conform to all modern standards, demanding safety as the first consideration, efficiency as the second, and a high class product as the third.

The manufacturers of mining equipment with their now large staff of engineers of the various classifications, have with the up to date coal operator, practically revolutionized the art of winning coal and I can visualize within the coming generation, coal mines as a manufacturing institution rather than the haphazard methods of the past.

However, there is one fly in the ointment, which is somewhat distressing, to those of us who are ambitious to see the actual stabilization of the industry in which we make our livelihood; that is the methods used by the representatives of the operators and miners in negotiating labor contracts. It is disheartening to know that we continue today in our labor relations and in our efforts to obtain labor contracts each year, two years or three, in the same manner as a quarter of a century ago.

Any threat of a strike and a shutdown of the mines, thereby creating frantic endeavors on the part of the consumers to obtain and store coal against an unknown period of no production at the mines, is an economic and rather silly crime. No one ever wins and the major portion of disrepute in which the coal operator finds himself today, is due to this fact. It must be worked out satisfactorily or the Government will do it for us. Although it may be late for such a cry in the wilderness, still, if we set about it honestly and sincerely, it may be accomplished.

* E. M., Chicago, Ill.

Quality Coal and COMPETITIVE FUELS

By J. D. Battle*

MEETING the demand for quality fuels is an intriguing subject, but so far as I and the National Coal Association are concerned, it is a question of meeting the demand for quality bituminous coal and coke as distinguished from all other fuels.

Connected with this idea of meeting the demand for quality coal, the additional thoughts such as creating a demand for quality coal and promoting its use as against other fuels are two of our main objectives in the National Coal Association. A great deal of work has been done and is being done on behalf of the industry in this respect.

It might be well to call attention, however, to the fact that it has not been so much a question of having difficulty in meeting the demands for coal during the past few years. The difficulty has been in finding markets. This very fact, however, has caused coal producers throughout the country to improve their product to make it into quality coal, if

* Executive director, National Coal Association.

it was not already of that character, and it may be that there has actually been some benefit from this fact, for sometimes adversity is a blessing in disguise. It is safe to say, however, that more attention is being given to the preparation and orderly marketing of bituminous coal now than ever before in the history of the industry, solely in order that the consuming public may become better acquainted with and more friendly toward the use of coal.

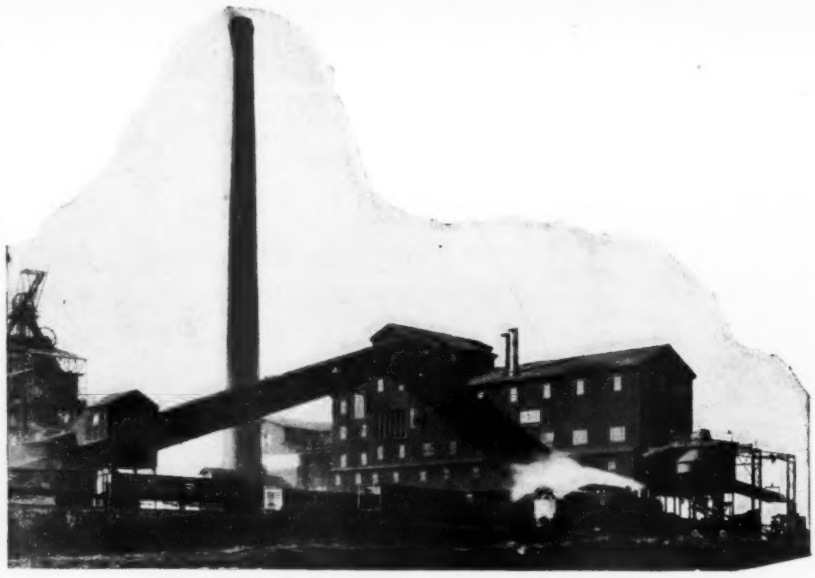
To take the subjects assigned us and suggested; for instance, the trend showing the market demands and possible future requirements. The market demand during the current year has been just about the production during the year, or a little better than production, as stocks on hand by industries on October 1, 1935, were 32,104,000 tons, compared with 27,235,000 tons on October 1 this year. Retail yards had less coal on hand October 1 this year than at the same time last year. The Lake movement during the past season has been the heaviest in the history of Lake transportation due largely to the fact that last winter was an extremely severe one in the Northwest and coal on the docks at the head of the Lakes had been practically used up.

About September 15 of this year production of bituminous coal had reached such a point as to warrant a statement to the public affecting transportation conditions. Extracts from that statement follow:

"Production is steadily increasing. Transportation facilities are scarce in some sections and are taxed almost to capacity in many others. New cars purchased by the carriers cannot be delivered in sufficient quantities to afford relief this year. Seventeen percent of the coal car equipment of the railroads is in bad order. The number of such cars owned by them is less than for many years. Coal stocks, both industrial and domestic, are too low for safety and should be replenished promptly. Mines now work only seven hours per day or 35 hours per week. Some mines are booked to capacity on certain sizes of coal for the next month or more. Balancing sizes is proving difficult at many mines. Wage negotiations commence in February, 1937. No one can predict the outcome. The present wage agreement throughout the industry expires on April 1, 1937. It is difficult to replenish stock piles during the winter months when the normal demand is heavy and transportation difficult.

"Coal for industrial use is being sold at excessively low prices. In view of all the conditions set forth above it is only reasonable to infer that under the law of supply and demand there is certain to be a material advance in prices commencing probably in the near future. These facts should command the serious attention of coal producers, wholesalers, retailers, and consumers throughout the nation.

"The National Coal Association proposes to keep the country informed weekly about conditions in the industry.



Cleaning Plant, Bell and Zoller Coal and Mining Co.

There can be no such thing as a shortage of coal at the mine, as mines are equipped to produce a much greater quantity than can be transported."

Since that time production has climbed steadily and reached a total of 10,258,000 tons for the week ending December 5. Production this year is 52,646,000 tons ahead of the same period last year.

The railroads have made extraordinary efforts from an operating standpoint to promptly handle the coal offered them. Improvements have been made in service and in the condition of equipment since their attention was called to it in September. The production, however, at the present time has about reached a point where the railroads again are being taxed to their utmost to handle the coal offered them satisfactorily. It is true that the carriers can slowly build up their facilities to a point where a larger tonnage can be handled but time is an important factor in this development.

This brings us up to what may be expected in the future, and naturally the answer is that the degree of industrial and business activity will govern the demand for coal. It is expected though that the demand during the first six months of 1937 will, to some extent, exceed the demand during the last six months of 1936. This prediction is based largely on the fact that the steel industry, automobile industry, and other large consumers of coal confidently look forward to an expansion of their business during the first several months of 1937.

Now, with reference to processes. Never before in the history of the bituminous coal industry has so much attention been given to making a better product. Every known mechanical device has been and is being adopted by producers to clean their coal, to size it properly and to meet the demands of the trade, as well as overcome the alleged superiority of other fuels. Oils and chemicals are being used to treat coal in order to avoid dust and this practice has developed to a point where some grades and sizes of coal not heretofore entirely satisfactory for household use are now in demand. Coal processed and placed in paper packages has been introduced by some of our leading operating and sales companies and difficulty is being experienced in meeting the demand for this specially prepared coal. Fine coal is used in preparing the blocks, which are molded into shape by a machine, held together by a composition that keeps it firm and permits the blocks to be wrapped in paper and the coal is then used in this original package just as prepared, the hand never actually touching the coal itself.

Technological developments include a tremendous amount of research that is going on within the industry. Bituminous Coal Research, Incorporated, an organization sponsored by the National Coal Association some three years ago, has within the past year really gotten under way and placed before the industry elaborate studies along the following lines:

"Efficiencies and Costs of Various Fuels in Domestic Heating";
"Progress Report on Coal Hydrogenation";
"The Relation of the Size of Bituminous Coals to Their Performance on Small Underfeed Stokers";
"Clinker Formation in Small Underfeed Stokers," and
"Combustion of Bituminous Coal on the Small Underfeed Stoker."

In addition to those special studies, the monthly reports of this research bureau are available to the trade as they relate in detail the excellent work that is being carried on in an effort to place on the market a more satisfactory fuel.

In conjunction with the work and supported by Bituminous Coal Research, Inc., are the progress reports of the Pennsylvania State College with respect to coal hydrogenation, etc. Bituminous Coal Research is collaborating with the Pennsylvania State College in this undertaking.

In addition to the research carried on by the above organizations, the Committee of Ten—Coal and Heating Industries, sponsored and supported by the National Coal Association, and representing 10 units directly concerned with the promotion of solid fuels, is meeting a crying need in the industry by devoting its time to the promotion of the use of stokers and all automatic heating and handling devices. The sale of stokers this year will exceed 100,000, an enormous increase over any previous year, and this is just the beginning.

The bituminous coal industry as represented by the National Coal Association is looking forward to bigger and better markets for bituminous coal and coke because of these several activities already under way. In furtherance of that idea, the Association just recently announced that an engineering department has been established within the National in charge of a well known and competent combustion and mechanical engineer. The sole thought behind this movement is to promote the use of bituminous coal and coke throughout this nation and advance it as a modern and up-to-date fuel.

It is well known that stokers are now available that require no more attention than any other automatic fuel-burning device. Experiments in research have developed the kind and size of coal that should be used to get the best results. The study goes on; the industry is market-minded; there is a coal for every purpose; there is a coal-burning device for every coal. Automatic heat with coal is our slogan. It will furnish more comfort than can be derived from any other fuel and as a rule it will cost less.

BITUMINOUS COAL RESEARCH, INC., Reviews Its Accomplishments

By John C. Cosgrove*

RESEARCH is often considered to be like the type of race horse which is a slow starter but which gradually picks up speed, passes the field, and with unfailing strength finishes far in the lead. In view of this comparison and inasmuch as the original program of Bituminous Coal Research, Inc., was outlined for three years as a minimum time in which useful results might be expected, it might be considered somewhat early to review the progress that has been made. Those in intimate touch with the program believe, however, that this research has been an exception to the general rule; it started rapidly, is now proceeding at a steady pace, and, if continuously and liberally supported, gives promise of continued success over a long period of years.

Bituminous Coal Research, Inc., is engaged in a unique undertaking. Research on coal is conducted by the Federal Government through the Bureau of Mines, by many state governments through their universities, and by various producers on their individual problems. Bituminous Coal Research, Inc., however, for the first time is sponsoring research, with funds provided directly from the industry, on problems whose solution will benefit all bituminous coal whether it is mined in West Virginia or Washington, in Pittsburgh, Pa., or in Pittsburg, Kans.

To insure that the efforts will be directed toward problems common to all producing fields and not be confined to one or a few, a majority of the voting stock is held by the National Coal Association, and the activities are controlled by a board of 15 directors who are representative of all districts. The program of research was chosen by the Research Committee headed by H. N. Eavenson, Eavenson & Alford, Pittsburgh, Pa. A Technical Advisory Committee made up of J. B. Morrow, preparation manager, Pittsburgh Coal Co., Pittsburgh, Pa., chairman; John Fielding, Jr., fuel engineer, Hanna Coal Co., Cleveland, Ohio; C. A. Reed, fuel engineer, National Coal Association, Washington, D. C., and J. E. Tobey, manager, Fuel Engineering Division, Appalachian Coals, Inc., Cincinnati, Ohio. The committee meets with the researchers at frequent intervals to review the technical details and approves technical reports before publication.

The Research Program

The funds available at the start of the program, although substantial, were modest when the proportions of the bituminous coal industry are considered. The problems were, therefore, carefully selected to insure that results usable generally in the industry would be obtained. It was divided into two general fields: (1) hydrogenation, and (2) domestic use of coal.

Research in Hydrogenation

Hydrogenation of coal to produce fuel oils and gasoline has been thoroughly investigated abroad and commercial plants are in operation in England and Germany. In the present state of development, it is not indicated that products made by the hydrogenation of coal could compete with those from petroleum in the United States. To improve the processes and to be prepared when the petroleum reserves approach depletion, which many say is not far distant, it was considered desirable to sponsor a small-scale program to survey the possibilities of hydrogenation of various bituminous coals of this country. There is always the possibility of discovering a new or better method which will make commercial hydrogenation of bituminous coal possible in this country.

This program has been carried on at the Pennsylvania State College. Results from the experiments at this institution have shown some essential facts in reference to American bituminous coals, although the amount of work that has been done so far with the limited funds available has been quite meagre.

The work has dwelt primarily with an investigation of the various conditions affecting the conversion of bituminous coals into liquid products and up to date the study has been confined to six coals. With respect to these coals, it has been shown that the degree of conversion into liquid products is dependent only upon the quality of inert material present in the coal treated and this inert material has been shown, in all these instances, to consist only of moisture, ash and fusain.

The results obtained by this research project to September 1, 1936, have been reported in Technical Report No. 2 of Bituminous Coal Research, Incorporated.

Research in Domestic Heating

Because most coal producers market a part, and some a very large part, of their production for domestic heating, and because the inroads of competitive fuels on this market during the past several years have resulted in a loss of an appreciable tonnage, the major attention has been given to coals used for heating.

The requirements of a fuel for domestic heating are that it be dependable, convenient, clean, and economical. As these requirements can be met with coal when used in the underfeed stoker which is justly gaining wide popularity throughout the country, an intensive program of research was initiated to insure that the utmost in satisfaction was attained with this equipment.

Fuels Laboratory at Battelle Memorial Institute

The accompanying photograph shows the Fuels Research Laboratory of the Corporation at Battelle Memorial Institute, at Columbus, Ohio. The combination of the extensive facilities at Battelle for research in fuels and the availability of many bituminous coals, together with natural gas and oil at Columbus made this an excellent location for the research program.

As a result of this research on small stokers, three publications have appeared and a fourth is ready for the press. One explains in language that the coal dealer and user can understand why and how the ash of coal forms into clinker in the stoker fuel bed and what measures can be taken to insure clinker when a coal with a relatively infusible ash is burned in the mild weather of fall and spring.

Size of Coal for Small Stokers

Many have recognized that coal crushes as it passes through the worm of the stoker but dealers have continued

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*President, Bituminous Coal Research, Inc., President, West Virginia Coal & Coke Co.

to supply coal to customers which had a top size of 1½ or 2 inches and often larger. The research laboratory has produced data on the extent of the crushing and has shown how the larger sizes of coal produce segregation in the fuel bed and uneven burning. Following the disclosure of these results, a marked improvement in the sizing of coal for stokers has been made. The Midwest Stoker Association has published in the form of a chart for retail coal dealers the top sizes of coal that should be furnished for the different sizes of the stokers manufactured by the member companies; a similar chart for all stokers will undoubtedly follow. The top size that they recommend for the residential size stoker is 1 inch which is in accordance with the findings of the laboratory. This movement, a direct result of the research, is leading to improved satisfaction in the use of bituminous coal.

Much of the information that has been published on the small stoker has been confusing to and has been misunderstood by the stoker salesmen and the retail coal dealers. To clarify their understanding a paper was prepared and presented before a recent meeting of the Coal Division of the A. I. M. E. which, again in simple non-technical language, discussed the functions of the various parts of the stoker, told how the coal burned, and in general the relation of the various characteristics of coals and their size to the performance of the stoker. This paper has had wide circulation and many requests for it continue to be received. It, too, will lead to better installation and adjustment of stokers, more intelligent selection of coals, and improved satisfaction with coal as a source of automatic heat.

A technical publication of the Corporation which will give detailed data on the effect of the size and the type of coal on the uniformity of operation, the clinker formation, the amount of smoke, and the efficiency of the stoker and coal will be published in the near future.

Battelle Investigates Fuel Beds

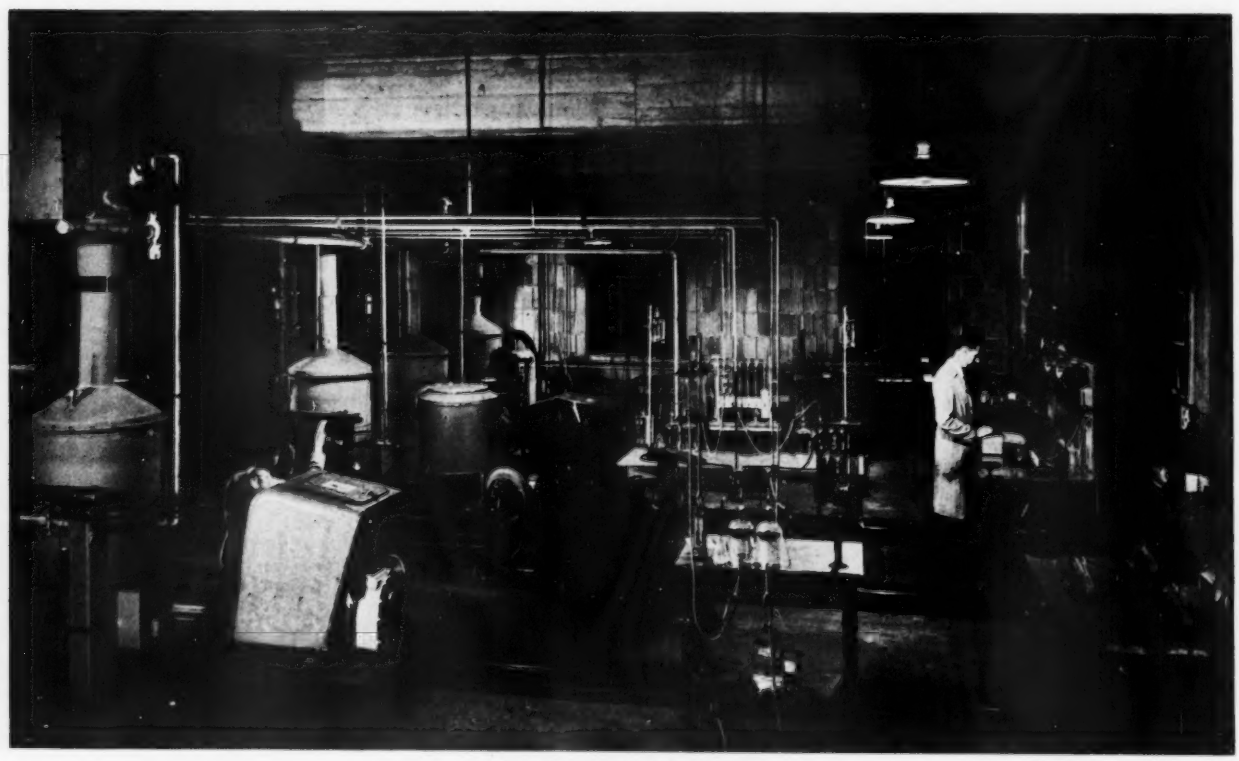
Battelle Memorial Institute is making an important contribution to the research program by its support of an investigation of what occurs in the fuel bed of an underfeed stoker. By examination of the rates of flow of coal, of air, of the temperatures in the fuel bed, and of the rates of chemical reaction, data are being obtained which will result in a knowledge of the proper design of retorts, tuyeres, and combustion chambers for improved performance of stokers.

Average Efficiencies and Relative Fuel Costs, Including Power and Ash Removal, with Fuels at 1935-36 Prices in Columbus, Ohio.

	Average Efficiency	Fuel Prices	Relative Cost
Bituminous coal, hand-fired	45	5.75—6.75/T	100
Semi-bituminous coal, hand-fired	50	6.40—7.00/T	89
Coke, hand-fired	70	7.35—8.35/T	87
Bituminous coal, stoker-fired	55	4.00—6.15/T	74
Natural gas, conversion burners	70	0.55/M.C.F.	147
Natural gas, designed burner boilers	75	0.55/M.C.F.	138
Oil, conversion burners	60	0.065—0.725/g.	164

Home Made the Testing Laboratory

During the winter of 1935-36, an unusual series of tests was made by the laboratory at Battelle Memorial Institute. To determine the extent of the various sources of heat loss that improvements might be made in the fuel-burning equipment, and to determine the efficiencies in the use of fuels to provide a more accurate basis for calculation of comparative costs of heating, a series of tests of various fuels in various types of furnaces was made, not in the laboratory, but in various homes in Columbus. The technical observers merely recorded the results; the homeowner attended the fire in his usual manner. Therefore the results are typical of actual operation. The above tabulation summarizes the average efficiencies and costs for fuel, including power and ash removal, at Columbus, Ohio, 1935-36 prices.



Fuel Research Laboratory.

These data which are given completely in a report now in press furnish the first assured basis for calculation of the relative costs of heating as the equipment will be installed, maintained, and operated in the average home. They also show the interesting fact that coal with stokers is the only method of obtaining automatic heat with which a saving can be made as compared with hand firing to offset the cost of the equipment required. With gas or oil, not only is it necessary to pay for the cost of the burner but it is necessary continually to pay more for the fuel.

The investigation demonstrated also the important fact that the best possible results of bituminous coal on stokers were not being obtained because of improper correlation of the stoker and the boiler, improper installation, and incorrect adjustment. Boilers and furnace designed specifically for stokers are badly needed. Many boiler and furnace manufacturers recognize this need; the results of this research will undoubtedly hasten their action to fill it.

Stoker Manufacturers Join Program

Recognizing the value of the research program to their industry, the Stoker Manufacturers Association have cooperated in the program and have made a contribution to insure that the work will be continued.

Dustless Treatment of Coal Studied

The use of oils to spray at the mine or at the retail yard started to insure dustless handling of the coal for the domestic consumer. It has become widespread and much coal for industrial plants is now being treated with oil. The correct quantity to use, the grade and type of oil, the permanence of the treatment, and the effect of oil on oxidation, feeding, and combustion characteristics of the coal are being investigated in the laboratory.

Recently, the Standard Oil Development Co., the Sun Oil Co., and the Viking Manufacturing Co. have joined with Bituminous Coal Research and have contributed liberally to the furtherance of this phase of the research program.

Coal for Industrial Stokers

With the program on the use of fuel in the home and in the small stokers well under way, a phase directed to the use of coal on the small industrial stokers has been started. A survey of conditions existing in industrial plants, of the type of coals they are using, of their satisfaction and difficulties with certain types, and of the causes and remedies for the difficulties is under way. The report on this survey will furnish an authentic cross-section of this important use of and will lead to further research on the particular problem that are found to be acute.

Laboratory a Source of Information

As the coal industry and the consuming public has become aware of the work of the research laboratory, an increasing number of inquiries are directed to it. Assistance is given daily to producers, dealers, consumers, and to manufacturers of coal-burning equipment on their problems in the selection and utilization of coal. Previously there was not available an authoritative and disinterested source for such information; this phase of the research program is well worth its entire cost.

Research Will Continue

These accomplishments of 18 months, although important, are but a first step in a program which will materially assist the bituminous coal industry on its way back to a profitable basis. With increasing support from the industry and from the National Coal Association, Bituminous Coal Research, Inc., will be able to initiate research in many other important fields. Further study of hydrogenation, production of colloidal fuel, carbonization and gasification, the use of coal for railroad locomotives and for highway trucks, and the vast field of coal as a chemical raw material are some of the realms in which research may be profitably directed.

Editor's Note—Only eighteen months ago, a program of research aimed to result in improved satisfaction in the use of bituminous coal was inaugurated by the industry. Long viewed as desirable by many in the industry, the program was made possible through the untiring efforts of a small group of men with vision, headed by John C. Cosgrove, President, West Virginia Coal & Coke Co. In the foregoing article, Mr. Cosgrove reviews briefly the accomplishments of the first eighteen months.

The Coal Industry's NEW OPPORTUNITY †

By Marc G. Bluth*

THE coal industry's new opportunity is obscure perhaps to many men in the operating end of the industry. Not only is this new opportunity obscure, but generally it is difficult for us to fully realize the changes which have taken place and which are taking place in the fuels market. Upon markets we depend for our livelihood. Without markets a meeting of this character would be useless. Men in the operating end of the coal industry have their own important and serious problems and consequently they have not always had the opportunity to study or to observe the changing trends in the market and demand for fuels.

This new opportunity is obscure even to those in the marketing end of the industry, but there is unfolding a broad vista of opportunities that is constantly changing the mining, operating and marketing of coal into an exact science. Competition from other fuels has been largely responsible for the new thought and action in the coal industry today. The difficulties of operators and retailers in recent years have been compounded because it has not only been necessary to hold customers from competitors within the industry but from the oil man and the gas man as well. It is this complexity that brought me into the picture about five years ago and set up what is at the present time my job—that prompted the organization of the Committee of Ten.

Briefly, I shall describe our activities and the phases of work which we have engaged in during these past few hectic and uncertain years. Only comparatively recently has come the realization that no fuel may presume to occupy the general market through "divine dispensation" and that each fuel will share the market largely in the measure it is aggressively and intelligently merchandized and contributes to consumer comfort, convenience and economy. The Committee of Ten is the culmination of a realization of the interdependency of solid fuel and related equipment interests in the solution of problems affecting consumer satisfaction. Its organization was prompted by self-interest, but of that shade termed by our friends and enemies both as "intelligent self-interest." The Committee of Ten is a sort of clearing house or national chamber of commerce for solid fuel and related equipment industries. It is an advisory body without administrative authority over any of its related groups set up to study mutual problems and offer suggestions and recommendations to the related industries for coordination of activities to the common end of consumer satisfaction in solid fuel utilization.

The name was suggested by the number of industrial elements identified with the formation of my organization which was ten. They were the National Coal Association, Anthracite Institute, American Wholesale Coal Association, Institute of Boiler and Radiator Mfrs., National Warm Air Heating Association, National Retail Coal Merchants Association, Heating and Piping Contractors National Association, National Sheet Metal Contractors Association, Midwest Stoker Association and Heat Control Manufacturers. Subsequently, there has been added to the membership the American Society of Heating and Ventilating Engineers, the National Association of Power Engineers, the National Association of Building Owners and Managers and the National Stoker Manufacturers Association. The active membership of the Committee of Ten comprises one duly designated delegate and one alternate from each member organization. Information is submitted by each delegate covering research and other activities of his own group along with any other suggestions and recommendations which may appear appropriate for consideration and discussion among the whole group. As a result of these contacts our organization has been able to prevent unwarranted duplication of effort in some instances and to offer helpful and constructive suggestions to individual groups as it pertains to the problems of the solid fuel industry.

Early in our history, we adopted and

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* Executive Secretary, Committee of Ten, Coal and Heating Industries.

offered three general recommendations to all groups which reflect quite clearly our policies. They are:

"That each industry as represented through its membership in the Committee of Ten establish standards if such are not already in existence by which its products and practices may be judged";

"That each industry confine itself to solving its own problems and the marketing of its own goods without indulging in unfair criticism of other allied industries";

"That each industry advocate and plan cooperative service to the public through personal contact among the respective members in any community."

In line with the idea of standardization, the National Warm Air Heating and Air Conditioning Association has adopted excellent codes covering plant installation. The Heating and Piping Contractors National Association has taken similar action in its certified heating program and in boiler ratings. This same association is also active at the present time in helping to establish, locally and nationally, standards covering the installation of air conditioning equipment. The Institute of Boiler and Radiator Manufacturers has standards covering certain classes of installation and the stoker groups are working on a number of standardization problems in cooperation with the coal industry including sizing and application of coal for stoker use, proper dimensions for boilers and furnaces when stoker fired and ratings for capacity. The Anthracite Institute has operated its own laboratory for testing and approval of equipment designed for anthracite burning. The National Coal Association, which is our chief supporter, representing the majority of production of bituminous coal in the United States, is now working on a research program of deep importance to the entire industry through a laboratory which has been established in connection with a famous research institution at Columbus, Ohio. Already stokers and coals of various kinds have undergone and are undergoing tests at this laboratory and at the present time standards of performance covering equipment for the utilization of bituminous coal are about to be established. All of this work has been undertaken by the individual groups, but through our office it has been possible to coordinate a great deal of the activity and in many cases to eliminate duplication of effort along engineering, research and marketing lines.

A considerable part of our work has concerned educational activities. This phase has resulted in the distribution of hundreds of thousands of specially prepared booklets and bulletins on many subjects having to do with the use of coal. We have cooperated with a number of universities in presenting this material to students and with the coal and allied industries in placing vital information in the hands of salesmen, coal dealers, engineers and many others engaged in allied businesses.

Time will not permit a thorough discussion of our activities. I have only indicated a few important points to which we have given our attention in the past few years. Our close contact with the heating equipment industry—boilers, stokers and all the various accessories—has given us the opportunity to study and observe many phases of our problems in the marketing of solid fuel which so vitally concern those engaged in production and preparation. Particularly is this true of the domestic market, or in plainer terms that part of your production which moves through the retail coal dealer and usually referred to as the heating load. Oh, the retailer has had his problems and still has them. Reams upon reams of paper have been used in discussing this particular part of coal marketing. If you think that you have all of the problems in the world, just hesitate for a moment and think what the retailer's problems are who is at the mercy of the coal preparation manager, the railroads, equipment for burning the coal, local legislative matters that are always present in any town or city and the personal likes and dislikes of the consumer. But it is through this man that the coal operator must operate and the retailer's problems are your problems.

This new opportunity which is so vague is being grasped by retailers and operators who are not afraid to face the actual facts. Our new opportunity is to take advantage of the tremendous resources which exist in our industry. By resources I mean not only the coal in the ground but the power that rests with you, your executive officers, your salesmen, your engineers and your retail and wholesale outlets, to present to the American consumer the story as it should be told about coal as a fuel. We have this new opportunity today because our friends in the heating equipment business have made it possible. Without equipment which has been and is being developed in the research laboratories of hundreds of companies, and then by experimental research and field experience, we would be sunk. But thank our lucky stars these men are friends of the coal industry and are as deeply interested in this problem as producers and retailers of solid fuel. They have had their troubles, too, but steady progress has been made even during the years when the prospects looked the darkest. You must know by now that I am referring to the automatic coal stoker industry, to air conditioning and to all of the innovations which have been introduced in recent years.

The small mechanical coal stoker was not known until about 15 years ago. It was pioneered out on the Pacific coast, thousands of miles from large consuming coal markets, and was gradually brought into this market after a few years of fairly successful operation in the West. In those days coal operators in the Rocky Mountain fields suffered terribly from a lack of market for their 2-in. and 1½-in. screenings. They had a good market for prepared coal sizes for hand firing, but for many years dumped hundreds of thousands of tons of screenings in each of these fields because they did not have a demand for their 2-in. and 1½-in. screenings. The small stoker came along. True, it was a crude affair compared with the present-day automatic coal burner, but it was something different. It was new, and as sales of the small machines increased, it helped the operators in those fields move an increasing tonnage of screenings. The small stoker was brought into the Middle West and the East. It was also introduced into the anthracite territory. A few farsighted coal operators and retailers in the Middle West invested their money in stoker plants and manufacturing facilities because they believed it promised a future not only to enhance their own pocketbook but because they were beginning to lose tonnage to oil and gas, and this machine apparently had the earmarks of something that would meet that competition.

So we bring the stoker up to the present day. What do we find? Nineteen thirty-five sale of stokers of all sizes and kinds for burning of all kinds of coal—bituminous, anthracite, and lignite—were the largest in the history of the industry. Oil burners, even in spite of being a record year in 1935, sold in the ratio of only 3½ to 1 as compared to stokers. This year we more or less expect a sales volume of about 100,000 units, double 1935 business. The big market for bituminous stokers is in the territory comprising Illinois, Wisconsin, Michigan, Ohio, Pennsylvania, Indiana, Iowa, Minnesota, Missouri, and Nebraska. Over 42 percent of the stokers sold last year were sold in this territory, according to a survey which our organization made the first of this year. These sales are being made to plants in every industry; to commercial structures of all kinds; and thousands of thousands

to home owners and apartment building owners. Hand-fired plants are being converted to stoker firing. Wherever possible, stoker manufacturers and their sales outlets are attempting to convert oil and gas users back to coal.

Small stokers have been and at the present time are being represented as and sold as basic units. Comfort, convenience, and economy have been attributed directly to the performance of the stoker itself. However, the stoker is not a basic unit. It can only be used in connection with a heating or air-conditioning system. The performance of the boiler and the heating system determines almost entirely what may be expected from the stoker. Stoker manufacturers are now taking steps to combine with their machine a boiler or furnace as an integral part of the modern heating and air-conditioning system. This is being brought about by the knowledge that we have been woefully weak in applying to new homes and modernized buildings modern equipment that places coal on an equal basis with competitive fuels. The combined unit today offers not only to the stoker manufacturer a new opportunity to present his equipment to the prospective buyer in a very favorable light but it offers to the coal industry a new opportunity to cooperate with the stoker manufacturer and allied organizations in showing the public that coal is an automatic fuel; that it is clean; that it can be made dustless, and that an architect or a builder can offer to his clients attractive equipment all in one single unit.

The architect and builder wield a lot of power. Remember they are salesmen, too. They are selling their services in competition with others. It is to their advantage to specify and build into their homes and apartments equipment that affords their clients the maximum in the way of comfort, convenience, cleanliness, ease of operation, and economy. Upon the coal industry's shoulders, along with the stoker people and manufacturers and designers of boilers and furnaces, falls the responsibility of driving home to the consumer the plain fact that coal is an ideal fuel when used with equipment adapted for its use. We are facing in this country a nation-wide building and modernization boom. Government statistics show that for the first seven months of 1936 the number of new home building permits increased 101.3 percent over the corresponding period in 1935. Surveys made have shown definitely that stokers as a general rule have not been installed in new homes now being built. There are exceptions of course, but generally this is true. This indicates that buying methods have changed. The engineer, architect, builder, and home owner no longer buy their heating plants piece by piece. Modern systems of different types have been designed and the entire plant is purchased at one time, which has done more than any other single factor to raise the standard of home heating. We can compare this with the purchase of an automobile today. Not so many years ago, when we bought new automobiles it was necessary to go to another store to buy a set of bumpers. All the other accessories were handled by different dealers. Today an automobile is sold as a single unit. Everything is attached. The bumpers are an integral part of your car. The spare tire is included. You can walk into a display room of an automobile dealer in the morning, order a new car, and that afternoon drive it out, completely equipped. All of the guarantees of the various manufacturers of the different parts in the automobile are contained in one envelope. That is the trend in heating equipment today. And it presents to the coal industry its real opportunity to share and to keep its business as this lusty building industry continues on its way up. Without this equipment we cannot hope to maintain our competitive position in this most important market.

Manufacturers and distributors of coal-burning equipment are beginning to realize its importance, but I am deeply disturbed when I learn that a survey conducted by an independent, reliable agency disclosed that of 500 new homes built this year in an eastern city, only 2 were constructed so that coal could be used as the fuel. A check of 75 homes in Detroit shows that not one single stoker installation was made. In 117 new homes built in Madison, Wis., this year, only 1 coalbin was specified. In 600 new homes built in Milwaukee during the last two years, only 25 coal-burning boilers and stokers were installed. In the city of St. Paul in 1935 over 1,000 oil burners were installed, and most of these were a combined boiler-burner unit. The pitiful part of this story is that the initial investment which a buyer makes in a combined unit for oil or gas is so high that he is very hard to convince that a change over to coal is the economical thing to do. I have kidded myself during the past few years, and others in the industry have also kidded themselves, that an oil-burner installation or a gas-burner installation is easy to convert to automatic-fired coal when the sales presentation is properly made. I must confess that this opinion which I held has been knocked into a cocked hat. Why? People don't buy oil burners or gas burners for economy. They buy for convenience, comfort, cleanliness, and sometimes from sheer downright laziness.

Some there are in our industry who still feel that the sale of stokers burning the smaller sizes of coal is reducing their market. Where they have customers using prepared sizes for hand firing, a deliberate effort is made to prevent these customers from going to automatic coal-burning equipment until they learn that they contemplate the purchase of oil or gas burners. This is a mistake. It is well to remember that every industry has grown as values and volume have increased and costs have decreased. On the other hand, many in our industry realize that this is an automatic age; that everyone is interested in equipment which will eliminate labor and reduce costs. These men know the value of their new opportunity, but for those who have not recognized this plain fact, they must discard their prejudices and tell their customers about this new equipment before they turn to competitive fuels.

All of this discussion is incidental to your main problems. Acknowledging that the consumer is the final judge, let us look back a few years to see what effect the installation of small stokers has had on the production and preparation of coal. A statement which came into my hands about 18 months ago showed that there was a large increase in the percentage of fine coal and a corresponding decrease in the percentage of lump coal from mines in Indiana and Illinois. When this statement was issued, an explanatory note was carried to the effect that this trend was not alone attributable to the increasing installation of small mechanical stokers. Increased mechanization of mines, higher production rates, and crushing of run of mine and coarse sizes were important factors. In 1932, Illinois produced 57.7 percent of railroad revenue lump coal, according to this statement. In 1934, the fine-coal production had jumped to 58.5 percent and lump-coal production dropped to 41.5 percent. Indiana showed even a greater percentage increase in the production of fine coal during this same period. Lump-coal production of railroad revenue shipments in that state in 1932 was 54.0 percent, and fine-coal production 46.0 percent. In 1934, lump-coal production had dropped to 34.5 percent and fine coal rose to 65.5 percent. Since I have not received a similar statement covering the year 1935, it is reasonable to assume that, in view of the record year for stokers in 1935, at least the 1934 percentage ratio was maintained, and very probably increased. That is, toward the larger production of fine coal with a corresponding decrease in larger sizes. We do not have statistics on other producing fields, but it is believed that the increase in fine-coal production will not be as great as shown for Illinois and Indiana. However, the trend nationally is definitely toward increasing production of small sizes adapted for use in mechanically fired equipment, and this development is continuing to have a greater bearing on the economic and commercial status of the coal industry. Undoubtedly it means that a readjustment will eventually be made in the price structure of bituminous coal both at the mine and delivered in the consumer's bin. The revenue from the sale of fine sizes will automatically be increased to offset the declining revenue due to the decreased sale of lump and coarse sizes which ordinarily command a higher price in the consuming markets.

Now some people might say that this is alarming to the stoker industry because sales of thousands of stokers have been based on its economy appeal, and in most of these cases on the difference between the delivered price of prepared sizes as against the smaller sizes for stoker use. But the stoker manufacturer today is placing his greatest emphasis on the convenience of automatic coal heat,

and he can do this and is doing it because the equipment is gradually being perfected to afford completely automatic heat. Along with the coal man, he is right up against the competition of other fuels, but we are witnessing the gradual rise in the price of oil as a heating fuel. A balance can be and will be maintained between the prices of these competitive fuels that will make it possible now and in the future to keep coal in its present competitive position, regardless of the increasing demand for stoker-size coal, as the stoker industry correspondingly increases its volume of business. I was interested to read a short article in the *Chicago Journal of Commerce* only last week by its coal editor as to the market for screenings. I believe that this article speaks volumes, and I quote:

"It's happening. It's happening sooner than expected. It was pointed out here two or three years ago to happen.

"Best grades of screenings are scarce and tight at the mines!

"The scarcity is at a time when screenings have been plentiful and soft in former years.

"The answer is the small stoker.

"Three years ago when stoker installations multiplied almost like rabbits, operators concentrated more on perfection of stoker sizes. Since the output of screenings decreases as the stoker sizes are made, it was predicted freely that within a few years screenings would come into their own. They are.

"Previously screenings were a drug in the market where production began to gain as the domestic movement increased. Screenings had to be sacrificed. In many cases they were sold at ridiculously low prices f. o. b. the mines. It was not uncommon for large buyers to obtain tonnages at the freight alone. Some mines virtually gave the screenings away in order to be rid of them.

"Came the small domestic stoker and a production race to increase outputs on stoker sizes and refine the product for the small automatic coal-firing devices. Operators are spending millions to improve stoker coals and production on the stoker sizes.

"During the last two years screenings supply was fairly balanced with domestic. It was a rare experience for the producers. This year, clearly, with the much greater increase in the stoker installations and the preparation of stoker coals, screenings already appear to be leading the domestic sizes. At any rate, several operators report screenings in as good, if not better, demand than the domestic lump, egg, and nut It comes at a time too when the domestic market is just about at its height.

"It seems fair to predict in the light of doubled stoker installations this year over a year ago, and another record year indicated for next year, that by next fall and winter many operators may be compelled to break down certain of the larger domestic sizes of coal for the increased requirements on the stoker coals. Some producers are already crushing lump for the purpose."

One exceedingly live subject today is the proper size of coal to be used in small mechanical coal-burning stokers. This subject is being discussed in every coal-producing field of the United States, and not only discussed but "cussed" by retailers and consumers in many markets who are floundering because of the lack of authoritative and unbiased information on the proper size or sizes or character of coal for stoker use. I do not believe that it is an impossible situation. I do not concur with some who think that some standardization of coal sizing for stoker use cannot be accomplished. I do state, and have stated many times, that it is necessary to correlate information and opinions from each coal-producing field in order that the problem can be better understood before starting any activity in this direction.

Lump Loading Ready for Last Layer.

This problem of establishing the most suitable sizes of coal for use with stokers involves the engineering, commercial, economical, and psychological phases of the coal and stoker industries. Fragmentary solutions have been offered, and perhaps the best solution is a combination of such fragmentary findings. The answer can only come through a development over a period of years while facts are determined, mine equipment modified, marketing methods developed, and inefficient stokers replaced.

An examination of a few phases of the problem might be helpful: Stokers differ in type; stoker types differ in characteristics as sizes change; moreover, there are about 250,000 to 300,000 stokers in service today. Many of these are of antiquated design so proportioned and installed as to require selected fuel. There is as much difference in old stokers of the same type and size as made by various manufacturers as there is between a modern high-priced car and some of the early automobiles which are now obsolete.

Some of the factors involved in sizing stoker coal from the utilization viewpoint are worth consideration. They are:

1. Steam or heating requirements of the fuel buyers.
2. Character, condition, or operation of the plant, as well as the mechanical stoker itself.
3. Geological location of the fuel user.
4. Competitive fuel prices.
5. Psychology of the buyer or user.
6. Freedom of choice of various fuels, relative desirability and adaptability for a particular requirement—real or imaginary.
7. Relative ignorance and indifference as well as something of the irresponsibility on the part of some sellers to the buyer as well as the fuel user to the public as to smoke or air pollution.
8. Operating characteristics of various fuels which influence the choice of a particular coal or a special size—to avoid certain use or operating factors, such as—

(a) Excess amount of fines requiring extra power to operate some stokers and higher pressure of forced-draft fan.

(b) Variation in coal sizes due to inability to duplicate deliveries—difficulty in adjusting for uniform air to coal ratio.

(c) Excess amount of dust or dirt in delivery or otherwise.

(d) Excess ash.

(e) Segregation of sizes.

(f) Noise of coal crushing with small underfeed stokers, due to the use of larger sizes, and requiring more power to operate the stoker.

(g) Hopper smoke due to too large percentage of coarse sizes.

(h) Dense fuel beds due to abnormally fine coal with formation of occasional blow holes, resulting in concentrated high temperatures and resultant clinkers.

(i) Excessive fly ash through use of coal with a too high or too low percentage of small size.

The right size of a given coal for any one stoker installation is easy to determine, but to prescribe sizes to cover a field, taking into account various types, designs, and vintage of stokers and embracing those built by inexperienced designers and manufacturers, is truly a

complicated problem. To this problem must be added the various classes of coal available with the producer's and retailer's problems of cost, disposal of other sizes, special equipment, and preparation. The problem, however, does lend itself to some analysis and by studying all of the elements, some average solutions may be worked out in planning for the future. It may be possible to establish a trend toward certain sizes as mine equipment will permit and economic factors dictate.

Small stokers having a capacity of 100 lb. of coal feed per hour or less present the most troublesome sizing problems. Here price, while a factor, is not the entire problem nor the major problem, and is limited only by the price of competitive fuels. Cleanliness, comfort, and convenience are very important. Noise is a nuicance. Power is important. Fuel for the small underfeed stoker must be separately considered from stoker sizes for other types and sizes of machines; particularly those stokers operated in industrial and power plants. In this classification there are three classes of small stokers to consider: First, old stokers installed before stoker design, building, and installing had reached the fine art that it is today; second, stokers of unbalanced design being built and installed by some companies untrained and inexperienced in stoker engineering and manufacture. Third, stokers built and installed by companies spending money and time on research. Such companies help both the stoker and coal industry. It is inevitable that only such companies can eventually survive. As the result of such research, 1936 models have, and 1937 models will have, more latitude than ever before in the matter of coal sizes and quality.

Some testing work on sizes of coal has been done at the laboratory of Bituminous Coal Research, Inc., located in Columbus, Ohio. This work is far too technical and the report too extensive to elaborate on here, but the immediate practical significance of these conclusions is that the top size of coal for small stokers need not be greater than ¾ in., or at the most 1 in. This work has concerned only sizing tests or the relation of the size of coal in the hopper to that which is burned in the retort. Four typical coals were obtained for the tests. Screening analyses were made of coal from various sections of the retort as well as before feeding coal and after feeding it. Two of the coals were treated with oil, as is common practice with a large tonnage of coal today, to render it dustless, and the effect of the treatment on the crushing and segregation was determined. Burning tests on the various sizes of the four coals are now under way. The elimination of the larger sizes which can be retained by the producer for his nut size, the report states, will not only reduce the work spent on crushing in the stoker but will decrease the difficulty with segregation of the large and small coal each time that it is handled between the loading at the mine and delivery to the consumer's bin. The report further states that oil treatment of coal did not affect the reduction in the size of coal but it did decrease the segregation both in the hopper and in the retort. These are only two of the general conclusions reached as a result of this work.

The work which has been done in your own field and the sizes of stoker coal which are being screened today indicate that some of the Columbus work agrees with the studies and experience of operators in this field, and that at least some standard top size or sizes may eventually be designated as the standard size or sizes for the industry. This subject has been given a great deal of attention recently in technical conferences all over the United States. It has also received some publicity in trade and technical magazines. The stoker manufacturer must and can devote his technical and field experience to this problem in cooperation with technicians and others in the coal industry who realize its importance to both industries.

In Illinois the coal industry is indeed fortunate to have such agencies as the Illinois Geological Survey, headed by Dr. M. M. Leighton, and the Department of Mining and Metallurgy at the University of Illinois, under the direction of Professor Callen. Some of the fundamental research which has been conducted by these two agencies has been and is of inestimable value to this industry, but unless these findings are applied and developed commercially, they become of little value. However, in this instance the research work conducted by your state institutions under the direction of technically capable and commercially minded men has made it possible to apply these results in the marketing of your coal as a refined product. More than anyone else, you know the desirable properties which are developed or enhanced by the preparation of your coal to meet market demands. Prof. D. W. Mitchell, of the University of Illinois, has listed seven of these properties, as follows:

1. Enhanced value due to careful sizing.
2. Freedom from rock impurities and sulphur balls.
3. Dustless.
4. Low ash and high calorific value.
5. Smokeless.
6. Sootless.
7. Uniform as to physical and chemical properties.

In removing impurities and by the proper sizing and cleaning of your coal, you are removing freight rate barriers. We all know, and it won't hurt to repeat again, the importance of transportation rates. It is part of the economic structure of our industry, and expert attention is being focused on it by national, state, and local organizations within the coal industry. The removal of impurities is one way to reduce freight rates. Accomplishing this, then we step to the expansion in the market which an improved product will create. In turn, an improved product reduces the cost of coal delivered and by converting a ton of coal into pounds of steam or millions of B. t. u's, it effects a saving for the consumer and places coal in a firmer position in so far as the competitive fuel situation is concerned. To illustrate, assume $2 mine price for a prepared and treated stoker coal; assume $3 freight rate to destination; delivered cost in dealer's yard, $5; assume $2 gross margin to dealer; delivered price into consumer's bin, $7. Now what elements are present in this breakdown?

1. Cost of mining, preparation, loading, and taxation;
2. Wholesale selling, administrative costs, and profit;
3. Transportation costs and profit;
4. Dealer handling cost and profit; and
5. Cost to consumer.

The American industrial system has been lax in providing intelligent publicity to illustrate in a simple manner to its ultimate users the distributing costs of any product. Thus a consumer who buys your coal at destination for $7 a ton on the assumed basis shown above—which is a prepared, dustless stoker coal—pays $7 a ton delivered in his basement. This consumer thinks this price too high. He complains even though he may secure heating comfort and satisfaction by using a good quality product. But he forgets unless it is simply illustrated that this $7 includes the costs of doing business and to afford a service that cannot be purchased in any other way. The fault does not lie directly with the coal operator or with the retail distributor. There is no fault to find except that there is a need for consumer education in our industry, as in all other industries, to sell if you please the average consumer on the merits of the delivered cost to him due to all of these factors which I have enumerated. Then if proper preparation, sizing, and intelligent selling of our product are carried through, the consumer will be a strong advocate because he is told and understands the simple reasons for the distribution cost of our product.

Now to illustrate another hypothetical case of an average customer residing in any one of the Middle Western States. He does not have modern coal-burning equipment in his basement. He buys coal, and it is sold to him on a price basis. His burning equipment is old or in bad shape. Perhaps he has not had his furnace or flues cleaned in 10 years or more. Perhaps he has a poor installation or perhaps he does not care. At any rate, how can he find out that he can improve his situation and eliminate his troubles if we do not tell him? But wait a moment. In the meantime, he will be approached by a clever salesman to interest him in an oil burner or gas burner. What will he do? This depends largely, of course, upon his own financial condition, but this salesman does not care about that if he can sell him on the idea of better, cleaner, and more convenient heat. He won't be able to save him money, but this salesman has another argument to offset the economy factor which is in favor of the prospect's present plant. This is, "don't burn this old-fashioned fuel in this old-fashioned furnace in this old-fashioned way.

Throw away the coal shovel. Install our 'super-super-super-burner' and we will eliminate your cleaning bills. You won't have to send your curtains to the laundry nearly so often; your upholstery and your rugs will be kept cleaner. Your wife will have more time for her bridge games, and Monday will be eliminated as blue washday." "Well," this man thinks, "Why not? My coal dealer has never told me about any new devices for handling and firing coal automatically. I have dealt with him nigh on to 20 years, and I haven't had any suggestions on how to improve my basement or heating plant." So he installs this burner—is proud of it. Now this is not an actual case. It is purely hypothetical, but actually there are hundreds of thousands of cases that are "in the bag" in so far as competitive fuels are concerned. There wouldn't be over 1,000,000 oil burners in this country if some appeal of this sort had not been made. There wouldn't be nearly a quarter of a million gas heating plants if the gas utilities had not recognized the tremendous importance of proper equipment in the application of their fuel and there wouldn't be a couple of hundred thousand stokers installed if it were not for the aggressiveness and merchandising ability of a handful of coal men who were losing their markets to other fuels a few years ago.

Another important point which we have been somewhat slow to grasp is the fact that the ordinary and average consumers are not interested in supporting any particular branch of the fuel industry. Because hundreds of thousands of men are dependent upon the mining of coal as a livelihood is no indication that people are just going to buy coal because they are contributing to the employment of miners and others interested in the industry. Coal is bought as a means to an end. So are oil and gas, but there is a lot of difference between these fuels physically, although their intention and purpose in life are the same.

In summarizing the trend in the preparation of coal to meet consumer requirements as demanded by all of these important marketing factors, it can be stated that every coal-producing field today is devoting its best engineering talent to improve consumer acceptance by the careful sizing and preparation of stoker coal. The Midwestern fields have led the parade in so far as washing and dedusting are concerned. Lower grade coals are being improved; medium grade coals are being improved, and in turn the higher grade coals are being improved, thus competing with each other; yet at the same time improving the standard of the industry to afford more satisfaction with solid fuels against a common enemy. In the oil-burner industry the problem of the proper fuel for use in heating plants has been simplified by the preparation and adoption of standards covering burning fuels. Before the adoption of these standards the oil-burner industry was so confused that it was necessary for oil refineries to step in and help the oil-burner industry in devising standards for oil fuels which could be adapted to the large majority of burners which were being marketed. These standards have been revised from time to time, and to the credit of the oil industry it should be stated that the fuels have been improved through perfected processing methods and, what is more important, through improvement in oil-burning equipment. In gas the problem is more simple, but even so the gas-burner manufacturers and gas producers and pipe-line companies have cooperated remarkably well in designing equipment and perfecting it for the burning of natural and manufactured gas. Our problem is more difficult. We have many coal fields in the United States; fundamental differences in the grade and quality of coal and important differences as to burning characteristics, particularly as applied to automatic stokers. There are many opinions held by capable engineers and executives in one field that differ violently with opinions within their same field and, of course, with the general opinions in competing fields. But these differences, in so far as engineering opinion and application are concerned, must be coordinated and adjusted even though it will not be possible to change the physical characteristics of the various coals in the various fields. Surely through careful analysis, through study of consumer markets, and through well-directed publicity selfish interests can be buried in order that the whole can be benefited. This must be done in spite of economic advantages enjoyed by one field as against another. Standardization of product is a most important factor in selling the product of one industry as against another, but this cannot be accomplished without the correlation of the different schools of thought within an industry.

Permit me in closing to quote from a statement recently made by Mr. A. W. Robertson, chairman of the board of the

Westinghouse Electric and Manufacturing Company. It tells a big story—so simply and yet so thrillingly if we are prepared to accept the challenge which research and science daily present:

"I am tempted to throw out a few suggestions of what we may hope for in the future. Within the next few years all unhealthful air will be purified. That is, we are going to undertake to purify our air just the same as we pasteurize our milk and purify our water and food.

"In the course of time, people in this country will develop migratory instincts, like the birds, . . . our food will gradually become so different that we will hardly recognize it. Everything we like to eat will be available the year around.

"Radio will become largely individualized so that for a little extra money, separated families and friends may talk to each other when and as often as they please.

"Cities will continue to be the focal point of admiration and despair. They will be practically noiseless. They will be intersected by great boulevards of fast-moving traffic. Double-deck streets will be common. It is even possible that our buildings in cities may be flat, so that by the use of lifting devices automobiles will be taken off the streets and stored on the tops of buildings.

"None of these things is very revolutionary, but to a certain extent they will change our habits and standards of living. Any deeply basic change is beyond anyone's vision. However, we may be certain that science will discover new ways to heal and save, new ways to kill and destroy, and out of it all we will have new joys and new sorrows."

Let's apply this to our own industry. The small automatic coal stoker has brought the coal industry new joys and new sorrows. It seems we cannot have the joys without the sorrows, but at least it provides a new opportunity to forge ahead in the increasingly exciting battle for our share of the heating business. How else can it be done? The small stoker is only a part of the picture. Perhaps there is a place for development of low-cost methods of producing smokeless fuels from bituminous coal. The tremendous market which air-conditioning is opening up will be helpful to the coal industry providing we will take advantage of these new opportunities. The modernization and building program presents a real challenge to our industry, and with the new thought it will be successfully met. There are others in these various industries who have a huge stake in this market, and they are spending the money to get their share of the business. The gas industry is already started upon a nation-wide advertising campaign to promote the use of gas for heating and other purposes. Stoker manufacturers will spend over $5,000,000 in consumer advertising in 1937. Organized groups of stoker manufacturers and dealers contemplate publicity and public relation campaigns nationally and locally next year. They are seeking more public acceptance of their products, and when they do this, coal will benefit.

STOKER FUEL

By Barton R. Gebhart *

THE widely advertised coal claim of "a size for every need" probably comes much nearer the truth since the arrival of the small stoker. There is strong reason to suspect that heretofore production needs have been chiefly responsible for the large number of domestic sizes produced for hand firing. This has not generally been the case with industrial sizes. Perhaps more real scientific attention has been given to the fitting of coal to power plants than to any other phase of coal selling.

But it took the small stoker to focus the attention of coal producers on preparation at mines of sizes of coal best adapted to the majority of existing coal burning plants, large and small. Now, instead of limiting his fuel engineering work to collaboration with large consumers in the fitting of coal to their plants, the progressive coal producer is devoting much time to the sizing, cleaning and treating of coal sizes specially designed for use in domestic and other small stokers.

Application of ordinary screenings or slack sizes is still being made successfully to commercial and industrial types of stoker units. It was at first believed that these sizes were adequate for small stoker use. But experience with a large number of smaller installations has shown that while raw screenings or slack may still be used on these machines, the resulting efficiency and satisfaction achieved does not approach that of which good stokers are capable. Consequently more and more stoker coals are being designed and offered for sale as more and more producers discover that participation in the rapidly growing and very desirable market for domestic stoker coal depends upon the production of a suitable size or sizes for such use.

What size is best, of course, is a very intriguing question. It is quite interesting that in seeking the answer to this question producers are giving the major weight to the so-called "utilization factor." Bituminous Coal Research, Inc., the industry's national research agency, gave early attention to the subject of coal sizing for small stokers. The corporation's first findings on this subject have been published in a report entitled "The Relation of the Size of Bituminous Coals to their Performance on Small Underfeed Stokers." This report is recommended to the attention of any producer concerned with this problem. In the foreword of the report it is explained that

"The recent rapid increase in the sale of domestic and small industrial stokers which are very largely of the underfeed type has made acute with the producers and distributors of bituminous coals the problem of the proper size to supply for this use. It would not be or expected that the best size would differ for coals of widely different type, but for one coal or group of coals it would be expected that there might be a size that would give optimum results with most of the stokers inasmuch as they embody the same general principles of feeding and combustion.

"However, the producers and distributors of coal find no general agreement among stoker manufacturers and dealers as to the proper size in which the coal should be prepared, and to meet the various demands they are frequently forced to prepare and stock several different sizes of coal. . . ."

The first studies had to do with the relation of the size of coal fed to the stoker hopper to that delivered to the retort to be burned. Involved here are the items of segregation and its effect on air distribution, crushing by coal feeding mechanism, and power requirements for stoker and fan motors. Varying sizes of four representative coals from different parts of the country were used in the original tests and among the conclusions were the following: (1) The percentage reduction in the size of the coal in the stoker was found to be definitely related to the hardness of the coal as expressed by the friability index. (2) The larger sizes of coal, +1 or +¾ in. and larger, so largely disappear in the coal that reaches the retort that it is not to be expected that the small amount remaining will materially affect the combustion of the coal. (3) The larger sizes of coal increase the segregation of coal in the hopper and in the retort. (4) An appreciable amount of fine sizes of coal, 39 per cent of —⅜ in. with the hardest coal and 65 per cent with the softest coal, was formed, although none was in the coal placed in the hopper. (5) The segregation of the sizes in the stoker retort was found to be less when using —¾ +0 in. coal than with the other sizes used. (6) Oil treatment of coal did not affect the reduction in the size of the coal, but it did decrease the segregation, both in the hopper and in the retort. (7) The immediate practical significance of these conclusions is that the top size of coal for small stokers need not be greater than ¾, or at the most 1 in. The elimination of the larger sizes, which can be retained by the producer for his nut sizes, will not only reduce the work spent on crushing in the stoker, but will decrease the difficulty with segregation of the large and small coal each time that it is handled between the loading at the mine and delivery to the consumer's bin.

In the laboratory of our own company we have carried this same line of research somewhat farther, in view of the contention of our fuel engineering department that for household size stoker units where the feed screws are relatively small and the clearance between the screws and the feed tubes is likewise small, a very small size coal such as carbon, measuring 5-16 in. x 0, with a percentage of the extreme fines such as minus 48 or minus 10 mesh coal removed, leaving small, uniformly sized pieces, would prove most satisfactory from the

* Vice president in charge of sales, Chicago, Wilmington & Franklin Coal Co.

standpoints of operating efficiency, cost, cleanliness, and convenience.

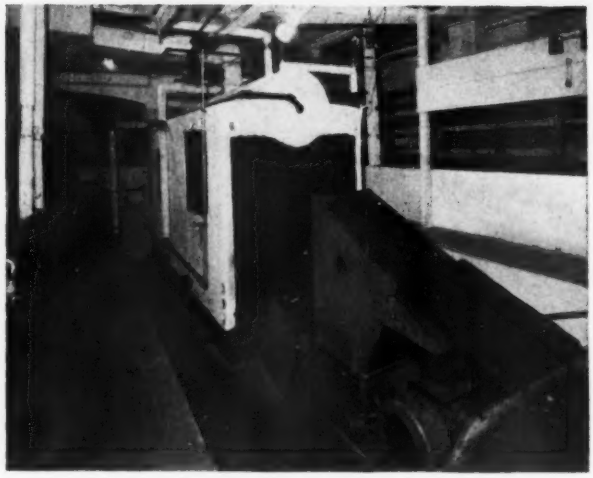
Through the use of some ingeniously devised laboratory equipment and several actual stokers, it was possible to measure with accuracy the distribution of sizes of coal in the discharge from the retort and to compare the results at the retort with the coal as placed in the stoker hopper. Tests were run on a number of sizes, but to illustrate the nature of the results, let us compare two sizes, 1½" x ¾", called "A," and 5/16" x 10 mesh coal, called "B." It was found, for example, that the air space per cubic foot of coal from different quarters of the retort varied nearly three times as much with size "A" as it did with size "B." Size "B," therefore, would be expected to give better results when under fire because of more even air distribution throughout the fuel bed.

In a small stoker, the operation of the feeding screw causes coal in the hopper to be moved or agitated. This causes the smaller pieces to filter downward between the larger ones. Even though a uniform mixture is placed in the hopper, if the pieces vary widely in size the smallest ones will work to the bottom more rapidly than the large ones. Because of this separation and also natural segregation in the feed worm, there is, from time to time, a wide variation in the size of pieces fed into the fire box, ranging from mostly nut pieces at one time to closely packed fines at another. Because of this variation in size of pieces there is a constant change in the amount and character of air space in the fuel bed, which causes the fuel bed to burn thin at one time and build up too thick at another. Small, evenly-sized pieces reduced this difficulty to a minimum.

Much less crushing occurred in the experiments when using size "B" (the 5/16" x 10 mesh), as indicated by the fact that 45 per cent more power was required by the coal-feeding motor per pound of coal fed, when feeding size "A," as compared with size "B." Depending upon local rates on power for home use, this variation would cause a difference of 10 cents to 15 cents per ton in power cost. Experiments with other sizes of varying dimensions between the chestnut and the 10-mesh sizes indicated that these other sizes were similarly less satisfactory in varying degrees than the uniform 10-mesh size.

Our conclusions from these laboratory experiments have been carefully matched against actual burning experience in the field. These experiences and observations lead to some general conclusions which we believe are helpful in promoting satisfactory small stoker performance. These general conclusions are that small, uniformly-sized pieces of coal are superior for small stoker use because (1) they avoid segregation and crushing and reduce power cost; (2) they promote uniform fire beds and most efficient burning; (3) they are keenly responsive to thermostatic regulation; (4) they require lower air pressure and less power for fan operation, and reduce fly ash; (5) they are clean to handle and to burn, especially so when oil processed; (6) they can be satisfactorily applied in the majority of stoker installations, cutting stoker tending to a minimum.

These conclusions are cited because I believe they are interesting and helpful in themselves, but also, and more in keeping with the purpose of this symposium, to indicate how important a part utilization has played and is playing in modern coal preparation. Of course, production needs and convenience are considered, but it's consumer satisfaction that counts.

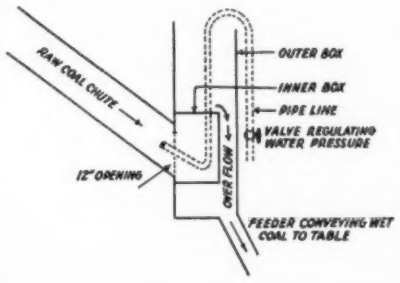


Modern Coal Stoker.

SCREENING Results Obtained at Empire Mine

By C. V. Barrow *

THE references below relate to a coal washer at Empire mine of the De Bardeleben Coal Corporation, where four Deister-Overstrom tables have been in operation for about 10 years. Within the last few months a new set of riffles for each table were installed. These riffles are different in design, both as to size, direction, etc., to those formerly used. This change resulted in improved efficiency and capacity.



Many washing systems are incomplete with reference to the washing units installed to cope with any combination of specific gravities, sizes and shapes of coal particles in the feed. Some complete plants, however, are designed to treat the largest sizes on jigs, the ½-in. size on jigs or tables, classifiers for the sizes ¼ in. to 65-mesh for tables, and froth flotation for the material through 65-mesh.

In an incomplete system a common abridgment of the flow sheet is to wash in the jigs all sizes from 1 in. down in one operation. A still further condensed plan is to clean all sizes 3 in. and down in one operation on one or more jigs.

In the two above methods, experience will show that the sizes below ¼ in. will be inefficiently washed. Usually a jig washing coal 3 in. and down adjusted to clean fine sizes wastes coarse coal; and if it is adjusted for coarse sizes it does inefficient work on sizes below ¼ in.

This is particularly true in a mine where the bottom is fire clay with an irregular surface and the coal undercut with electric mining machines. The undercuttings from the seam will, with the additional extraneous fire clay, show exceedingly high in ash. This is the case in this instance.

Our chief objective in changing the design of a former plant handling 3 in. and down in one operation by adding more washing units was to better clean the sizes ½ in. and down. After factory tests on the ½-in. run of mine were submitted, the management decided to install four diagonal-deck tables. The results hoped for were obtained by this particular method of cleaning. The factory experiments definitely determined

* Chemist, DeBardeleben Coal Corporation.

that excellent results were possible by this particular method of cleaning on this size coal.

In order to wash coal on a table it must be sized uniformly. This was accomplished by two Leahy screens. The screened product was mixed to some extent by conveying the coal in a drag conveyor over a large oblong bin. A good mixture of the feed to the tables saves a number of minor operating adjustments, especially where mining methods are used resulting in relatively clean coal at intervals and more or less high-ash coal from different places in the mine coming in between the trips of clean coal.

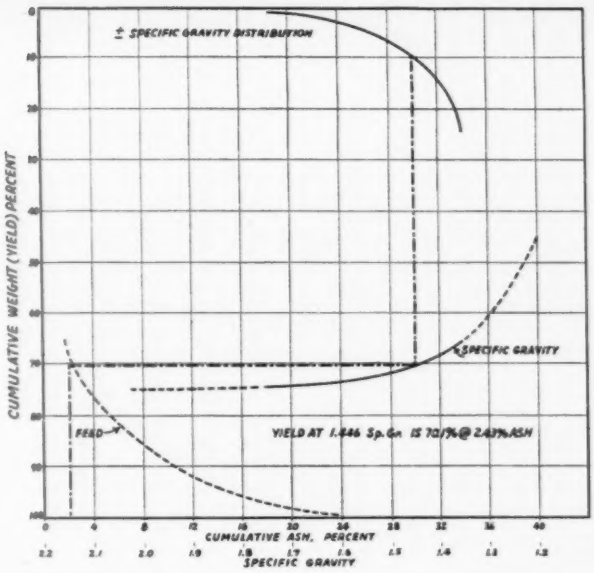
Commercial specifications on coal ½ in. and down required for by-product plants' pulverizing systems and blacksmithing concerns are attainable only from washing units of high efficiency, with resulting economy to the operator.

In marketing slack coal, or in using it for by-products, the saving in fines ⅛ in. and down in the washing operation became a profitable item. The pronounced saving of fines immediately indicated from the new units seems to be an outstanding feature in favor of a jig-table system. The reject from the tables is usually low in loss of coal at 1.40 specific gravity. The relative small capacity of approximately 50 tons per day per unit is offset by the higher efficiency when compared to jigs washing 200 to 300 tons per day.

Table adjustments, especially on new installation, should be made under the supervision of one entirely familiar with factory specifications. Our experience indicates that the operators of the other types of washing equipment have to acquire a skill for delicate adjustments on these units. When possible, the washed products should be checked by the usual float and sink determinations, and also by chemical analyses from day to day, for best results.

The conditions of efficient operation are governed not only by set specifications, such as number of strokes per minute to the deck from the head drive, length of stroke, inches, cross-slope, inch per foot, coal washed per hour, maximum height of high riffles, inches; spacing of high riffles, inches, but by such niceties of adjustment as uniformity of flow of the feed coal, correct angle of feed chutes from raw-coal bins, correct amount of water to be used, uniformity in discharge of washed and reject products.

As little water as will maintain mobility is recommended, experience has shown that too much water hastens the separation to the extent that some of the heavier material is swept into the washed coal instead of being discharged on the lower edge of the table. The distribution of products discharged along the coal side, or the long side table, is a factor of great importance in best performance. For best results it is found that 2 to 3 percent comes off in the first foot along the deck nearest the head drive, 27 to 30 percent along the first 5 ft., the remaining washed products taper off uniformly so that a small portion comes over the middling corner of the table as a middling product.



After considerable trouble in regulating the feed coal through the chutes from the bin to the tables, our washer foreman designed a hydro-box or water-pressure box, which controls the amount of coal fed to tables by closing or opening a valve in the water line extending into the chute. The coal is flumed into an inner box (see Fig. (1)), and is caused to overflow into an outer box, falling from the outer box through a small outlet onto the table.

This form of feed has given such satisfactory results that the feed requires little adjustment, thereby reducing the cost of operation by elimination of men to adjust the feed.

The arrangement of the first five riffles on the top side of the new table differs from that of the former riffling. Two coal riffles ⅜ in. by ⅝ in. with 3 in. between riffles and three slate riffles ¼ in. by ¼ in.—all riffles 1⅛ in. in the clear, give to the table a decided selective separation on size and shape of refuse particles coming off from the top side of the refuse discharge. An increased capacity of ½ ton per hour is noted on our new installation.

In order to understand what results would be expected in the washed coal, a study of the feed coal to three tables was made. The results are shown in Figure 2 (graph).

Float and sink tests on feed coal to three tables:

Specific gravity	Weight, pct.	Ash, pct.	Cumul. wgt., pct.	Cumul. ash, pct.
Under 1.35	65.3	1.80	65.3	1.80
1.35 - 1.45.....	5.1	10.60	70.4	2.44
1.45 - 1.55.....	2.1	21.90	72.5	3.00
1.55 - 1.75.....	1.8	34.30	74.3	3.77
Over 1.75.....	25.7	82.30	100.0	23.95

The values read from the cumulative weight percent against the cumulative ash percent curve (left), against specific gravity curve (right), and against plus-minus 0.10 specific gravity distribution (top) predict what may be expected from the washed coal.

The gravity at which points of equal difficulty would occur is 1.446 sp. gr. with a yield of 70.1 percent @ 2.43 percent ash.

The theoretical ash at 1.37 gravity read from the curves is 1.85 percent ash. By adding 1 percent to 1.85 percent ash, an ash of around 2.85 percent may be expected in the washed coal, with a corresponding yield of 73 percent read from the cumulative weight, ash, percent curve.

By introducing a rewash system on one of the tables which handles ⅝ in. and down prewashed coal from two jigs, and by screening the washed table products from the four tables over a 1-m.m. wedge-wire screen, better results in yield and ash content were obtained than are predicted by the float and sink tests in the washability study.

The coal from the jigs to the table in the rewash system has an ash content of 12 to 15 percent. This table produces a coal of 2.50 percent ash. The wedge-wire screen by screening out impurities under 1 m.m. reduces the ash in the coal .2 percent (two-tenths).

The results of coal collected from four railroad cars are given as follows: It must be understood that these results are not comparable to what is predicted by the study of the feed coal as the flow sheet denotes the addition of a rewash system, and a wedge-wire screen into the general scheme of the original plant arrangement.

Ash in the composite sample from four cars, 2.60 percent.

Float and sink tests on this four-car sample:

Specific gravity	Weight, pct.	Ash, pct.	Cumul. wgt., pct.	Cumul. ash, pct.
Float at 1.35..	93.7	1.90	93.7	1.90
1.35 to 1.45...	4.2	9.80	97.9	2.24
1.45 to 1.55...	1.4	20.70	99.3	2.50
1.55 to 1.75...	0.7	32.10	100.0	2.71
Sink at 1.75...	0.0	....	....	...

It is interesting to note that in 47 cars of ½ and down coal to a by-product plant for "coke-oven purposes," the ash content ranged from 2.10 percent ash to 3.55 percent ash, giving an average ash content of 2.61 percent ash.

The results indicated from the four railroad cars shown have been verified over a period of months on a large tonnage, and it is evident that a uniform low-ash product can be made by using this type of equipment.

Regularity of the flow and sizes of washed product are insured by different screening of the run of mine 3 in. and down and the continuous regular disposal of the table products.

The reduction in loss of fine coal by the use of this table equipment, as compared to the loss of fine coal on jigs, and the further fact that a lower ash product is obtained, illustrates the splendid advantage of the use of these tables under conditions mentioned. In addition, there is the advantage of rewashing the fines from the jigs, which type of equipment is not satisfactory for this size coal.

CHEMICAL TREATMENT of Coal to Allay Dust

By R. H. Sawens *

FOR the past several years increasing competition in the marketing of fuels has brought sharply to the attention of the coal producer as well as to the dealer the necessity for rendering his product more attractive to the consumer. Elimination of dust offers a means to this end.

Dust-proofing treatment is widely practiced in many areas, including both producing and retail points. However, the recent tendency has been toward treatment at the mines rather than at dealers' yards. Mine treatment has the advantage of greater uniformity; and further, when using treating materials which have anti-freeze properties, mine treatment makes it much easier for dealers or users located in cold climates to unload the cars. In fact, during the winter months many thousands of tons of coal are being treated annually by producers primarily to minimize freezing in transit.

A variety of products have been promoted for dust-proofing purposes, the most commonly employed being hygroscopic salts such as calcium chloride or mixtures of calcium and magnesium chlorides, the dust-laying properties of which are well known. A little glycerine has been included in some cases. These substances have the property of absorbing moisture from the air or from their surroundings until they become liquid, i. e., dissolved in the absorbed moisture. As employed for dust proofing, they are usually dissolved in water before applying to the fuel. Such solutions, because of the hygroscopic nature of the dissolved salts, do not evaporate or dry out completely under normal conditions. Their action in dust proofing constitutes simple dampening of the fuel in such a way that it remains slightly damp and free from dust almost permanently.

The products mentioned, in common with many other hygroscopic salts, give solutions having low freezing points, which accounts for their success in prevention of freezing during cold weather. The twofold action of dust proofing and anti-freeze appeals to many users.

Calcium and magnesium chlorides have been reported to be corrosive to equipment used in the treating and subsequent handling of the fuel. There may be some justification for this claim, not because the chlorides are inherently corrosive, but owing to the fact that a piece of metal wet with the solution remains wet for a long period. Air in contact with a film of the solution produces corrosion just as it does with a film of ordinary water. Water, however, soon evaporates, so that the corrosion does not progress as far.

Users of the chlorides have found that simple measures afford adequate corrosion production. These measures include the regular washing down of equipment after use, or coating such equipment as is feasible with protective paints. A number of rubber base paints now on the market have been found satisfactory. At some treating locations cheap oil, such as waste crank case oil, is used occasionally on moving parts; for example, on conveyor chains. Treating sprays in exposed locations are often shielded from the wind by use of screens made of sheet metal or old rubber belting, thus preventing abnormal losses of treating material and minimizing its spread to other nearby equipment.

Many users of hygroscopic chemicals have applied larger quantities of solution than necessary, with the result that the fuels were saturated and there was much subsequent drippage and wastage. Such conditions tend to promote unnecessary corrosion of handling equipment. It may be mentioned, however, that at mines which are accustomed to dealing with the corrosive action of acid mine waters, the relatively light corrosion associated with the application of chemicals is generally considered negligible.

More recently, light petroleum oils have been used to a considerable extent for dust-proofing purposes. These oils are not hygroscopic, but depend for their effectiveness on the slowness of evaporation of the oils themselves. Such treatments have been found, in some cases at least, less permanent than those involving hygroscopic materials. This lack of permanency may be due both to skimpy initial treatment and to loss of the oil by evaporation.

While oils of this type are essentially noncorrosive, there are certain other details which should be considered. The well-known inability of oil to mix with water renders the treating of wet coals difficult. Oil-water emulsions have been tried, using enough of the emulsion to furnish excellent but temporary dust proofing. The water soon evaporates, leaving insufficient oil to control the dust.

Oils such as are used for coal treating in general congeal at relatively high temperatures, as compared with the chlorides. For cold-weather use, therefore, the storage tanks for such oils must either be located in a heated building or protected by some type of heating unit. Both steam coils and electric resistance units have been employed.

There is another type of treating medium which has been tried to some extent. Reference is made to materials which cement or glue the dust particles to the larger lumps or to each other, but do not remain damp or oily. The principal material of this type is a by-product of the sulphite pulp industry, the sulphite liquors containing materials extracted from the wood being concentrated by evaporation to form the glue-like binder. Such a binder serves very well as a temporary expedient, but the dry fuel on being rehandled again develops dust.

Equipment necessary for the dust proofing of fuel has passed through several stages of development. The early type of unit, wherein calcium chloride solution was employed, consisted simply of dissolving or dilution tanks, and an elevated tank from which the solution discharged by gravity flow to home-made nozzles located near a moving stream of fuel. Compressed air was generally used for agitation in the dissolving or diluting operation, and the liquor was pumped from these tanks to the elevated tank as required. A suitable strainer was included in the pipe line to remove any scale, dirt, or other sediment before passing through the nozzles.

The high-pressure treating unit, operating at from 200 to 350 lb. pressure, soon became popular, on the premise that the smaller nozzle openings and finer atomization obtainable thereby produced adequate coverage with lesser quantities of solution and lesser tendency to overtreatment. This type of treatment did away with the overhead tank but required a solution pump capable of operating at the required back pressure. For the most part, multiple cylinder reciprocating pumps have been used, provision being made also for a relief valve and return line on the pressure side of the pump to permit flow of solution back to the tank when the pressure exceeds that desired. Meanwhile, nozzles better suited to the high-pressure type of atomization were introduced to the trade. There is a considerable variety of satisfactory nozzles on the market.

* Technical Service, Laboratory of the Solvay Process Company, Syracuse, N. Y.

With further experience in fuel treating, there has been within the last two or three years a movement back to lower treating pressures; that is, a happy medium between the very low pressures originally employed and the relatively high pressures which followed. It was found that the very finely atomized mists developed at the higher pressures are difficult to control or shield, so that even a slight movement of air in its vicinity results in wastage of the treating medium, the coating of equipment within its reach, and discomfort to workmen. Further, the very small nozzle orifices employed for high-pressure treating are more subject to stoppage by particles of scale or other foreign matter which may pass the strainer or originate beyond it. With lower pressure equipment, general maintenance is simpler and less expensive. Pressures ranging from 30 to 300 lb. per square inch are giving excellent results as to spray coverage and economy. A number of treating stations are now using centrifugal pumps rather than the reciprocating type for this work. These remarks relative to use of lower pressures apply to treating materials other than oils.

In early treating practice there was considerable uncertainty as to where in the coal-handling process the solution should be applied with maximum convenience and effectiveness. In some installations the nozzles were placed directly over a conveyor belt, but here the coverage on the coal next to the belt was imperfect unless excessive quantities of solution were applied. It was soon recognized that the establishing of a spray area around a falling stream of coal was productive of the desired results. In most cases the discharge end of a loading boom or chute was the treating point chosen.

Higher pressures at the nozzles were helpful in developing the kind of fine spray desirable for this type of treatment, but as indicated previously, the very fine mist sprays are to be avoided because of difficulty in holding them within reasonable bounds.

The most recent studies of spray-nozzle location in treating fuel during car loading have demonstrated the advantage of placing the nozzles underneath the fuel stream and boom rather than out in front of the stream. The spray direction is designed to aim both at the dropping fuel and at the fuel as it rolls down in the car. A suitable arrangement of this type permits excellent coverage with minimum loss of treating agent by air current.

In this brief review no attempt has been made to furnish a detailed description of treating equipment and practice. However, emphasis should be placed on the avoidance of over-treatment. Applications of solution should be sufficient to adequately and permanently lay the dust, but not in quantity to produce appreciable run-off or drippage following the treatment. The spray location should be shielded as much as possible to prevent blowing of the spray. Treating at as low pressures as practical is of assistance, since the larger droplets produced at lower pressures are less subject to movement by drafts and breezes. Metering or other measurement of uniformity of solution applied should be regularly practiced and suitable records maintained. Suppliers of equipment and chemicals usually stand ready to assist in bringing about these results.

The "BLACK KNIGHT" Mine No. 6 Refining Plant

By Ellsworth H. Shriver *

THE Raleigh Coal and Coke Company, with its mines at Raleigh, W. Va., has the distinction of being the pioneer producer of the famous Beckley seam smokeless coal. The first commercial mine operating in the Beckley seam was opened at Raleigh in 1898, and was called Raleigh No. 1 mine. This mine is still producing a small tonnage. The above company also enjoys the distinction of being probably the first operating company in West Virginia to market a coal protected by a registered trade mark. The idea of registering Raleigh coal was first conceived by A. A. Liggett, vice president and treasurer of the Raleigh Coal and Coke Company, and president of its sales company, Knight Products, Inc., almost 30 years ago.

During the long life of these properties, every effort has been made to market a quality product, and no expense has been spared in installing equipment necessary to keep "Black Knight" coal constantly in the foreground.

Since the close of the great war, marketing conditions in the bituminous coal industry have undergone many changes. As new burning equipment has appeared on the scene, new operating equipment has been found necessary to provide the kind and quality of coal demanded. Accurate sizing and elimination of all impurities in the smaller sizes, as well as in the larger, has become two of the chief problems confronting the operating executive of today.

During the life of these mines, the greater part of the product was shipped as domestic run of mine and the resultant slack. Careful supervision at the loading face and hand picking at the tipple was relied upon to keep the coal in the foreground as a quality coal.

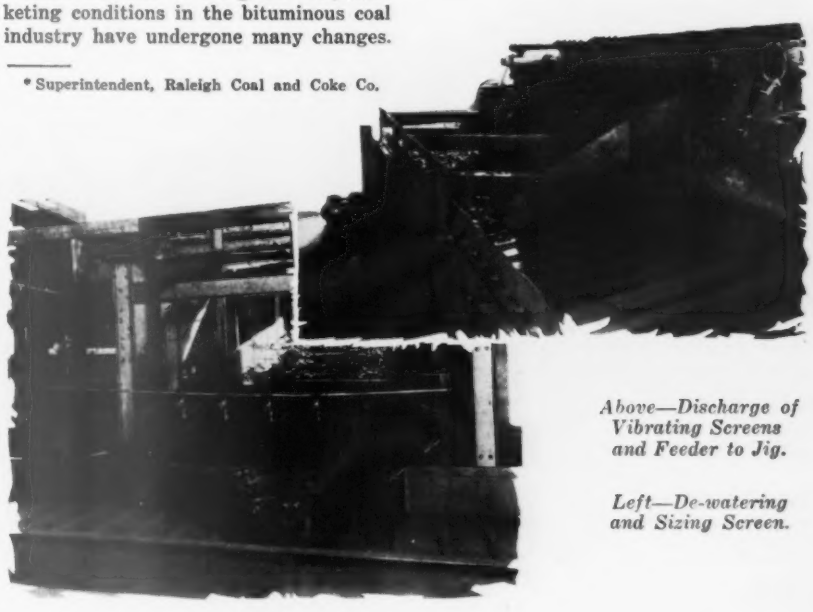
As the change in market requirements and the demand for smaller sizes increased and also with the increased difficulty in obtaining clean coal from the face due to the greater proportion of pillar mining, the management of the company became convinced that mechanical cleaning would be necessary.

After considerable investigation, a washing plant, with the attendant screens, conveyors, etc., was purchased from The Jeffrey Manufacturing Company, Columbus, Ohio, late in 1935. It was erected by Raleigh Coal and Coke Company labor. The washing unit purchased was a three-compartment, Baume type jig with automatic control of the refuse elimination. Due to the extremely cold weather of last winter, the plant was not completed and placed in operation until May 18 of this year.

The flow sheet of the plant is extremely simple, as may be seen by a study of Plate 1. The existing tipple was a well-designed steel structure, and lent itself to the additional equipment with but very little alteration.

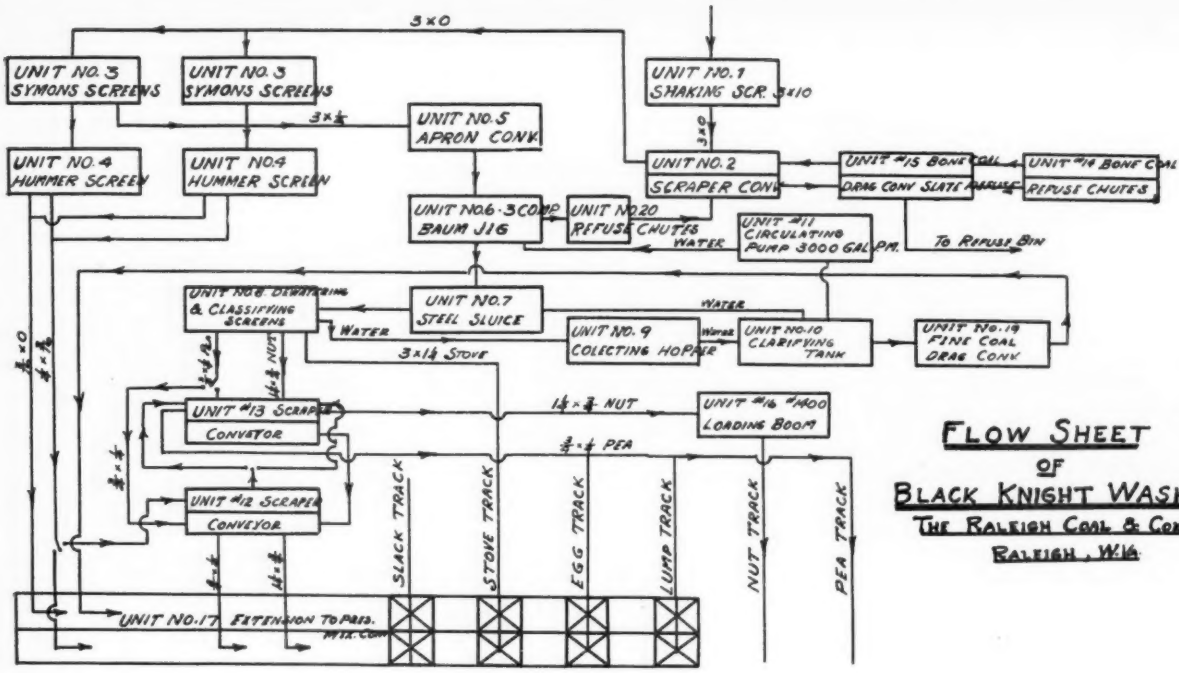
The results attained in the accurate sizing and the cleanliness of the marketed product have been highly satisfactory.

* Superintendent, Raleigh Coal and Coke Co.



Above—Discharge of Vibrating Screens and Feeder to Jig.

Left—De-watering and Sizing Screen.


3×0
UNIT NO. 3 SYMONS SCREENS
UNIT NO. 3 SYMONS SCREENS
UNIT NO. 7 SHAKING SCR. 3×10
3×¾
UNIT NO. 5 APRON CONV.
UNIT NO. 4 HUMMER SCREEN
UNIT NO. 4 HUMMER SCREEN
UNIT NO. 2 SCRAPER CONV.
UNIT #15 BONE COAL DRAG CONV SLATE
UNIT #14 BONE COAL REFUSE CHUTES
UNIT NO. 6 3 COMP. BAUM J16
UNIT NO. 20 REFUSE CHUTES
WATER
UNIT #11 CIRCULATING PUMP 3000 GAL P.M.
To Refuse Bin
UNIT NO. 8 DEWATERING & CLASSIFYING SCREENS
UNIT NO. 7 STEEL SLUICE
WATER
WATER
UNIT NO. 9 COLECTING HOPPER
UNIT NO. 10 CLARIFYING TANK
UNIT NO. 19 FINE COAL DRAG CONV.
3×1¼ STOVE
1¼×¾ NUT
UNIT #13 SCRAPER CONVEYOR
UNIT #16 #1400 LOADING BOOM
¾×¼ PEA
UNIT #12 SCRAPER CONVEYOR
SLACK TRACK
STOVE TRACK
EGG TRACK
LUMP TRACK
NUT TRACK
PEA TRACK
UNIT NO. 17 EXTENSION TO PREP. MIX. CONV.

FLOW SHEET OF BLACK KNIGHT WASHER

THE RALEIGH COAL & COKE CO.
RALEIGH, W. VA.

The plant produces six grades of coal, as follows:

+7"	Lump
3" x 7"	Egg
1¼" x 3"	Stove
¾" x 1¼"	Nut
¼" x ¾"	Pea
—¼"	Slack

The plant is arranged to mix any and all grades in any proportion desired.

A very considerable reduction in ash has been effected in the stove, nut, and pea coals, the sizes washed. A considerable reduction in ash on a run of mine basis has been effected, from 5.80 percent ash to 4.17 percent ash, or a reduction of 1.63 percent.

With the high temperatures of the modern forced draft burning equipment, the fusing temperature of the ash has become one of the important factors in the combustion of coal.

The Raleigh washing plant has been instrumental in raising the fusion point of the ash in the sizes washed more than 100° to an average of about 2,900°.

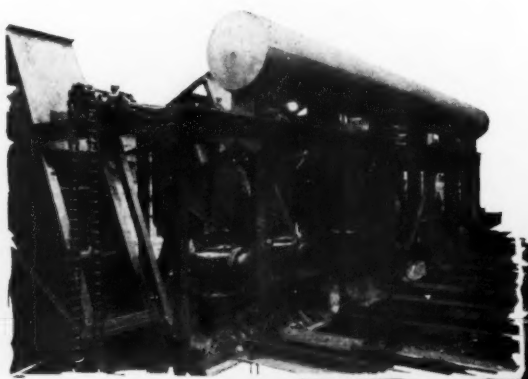
The b.t.u. value of all the washed sizes has been increased more than 300 to an average of better than 15,000.

The sulphur content of all the washed sizes has been decreased to about 0.75 percent.

The user of coal who purchases his product on a sound engineering basis, demands coal of low ash with a high fusing point, low sulphur, and a high b.t.u. value. In addition to those qualities, he also demands a coal on which he can depend to be consistent and regular in these desirable qualities.

One of the most satisfactory characteristics of the plant installed at Raleigh has been the consistency and regularity of the washed coal product. Since the washer has been in operation, there has not been a complaint as to the quality of the washed coal.

In line with the policy of the company to market only the highest grade product, the necessary equipment was installed in this plant to dust-treat any and all sizes of coal with the use of hot oil under pressure.



Left—View of Jig Showing Air Mechanism.

Right—Two Compartment Nut and Pea Conveyor.

Of All Things . . .

Maybe there's a healthy sign about absence of recommendations in Secretary Ickes' annual report for building any new Government buildings. . . . Still when one stops to remember that during the past year the Administration signed 197 leases for rented space in 123 different buildings for 2,766,000 square feet of office space at an annual rental of $2,640,000 it seems that a new building or two might be good business for Uncle Sam. . . . That rental total doesn't include an additional $1,150,000 for improvement and repairs of Federal buildings and rental of a warehouse in Baltimore for the Social Security indexing quarters. . . . The recently completed huge Interior building with its 700,000 square feet of office space will be only a drop in the bucket in solving the space problem of the fast spreading Federal bureaucracy. . . .

If a man can't remember his motor car license number we'd like to know how he'll be expected to remember the number of his Social Security account. . . .

An enterprising jeweler has suggested to the Government that it give a badge to every person paying his taxes. . . . Okeh . . . but what's the badge going to be pinned on after he gets through paying his taxes? . . .

In the good old days everybody thought that the Department of Agriculture had its hands full looking after the growth of peas, corn, wheat, barley, oats and beans. . . . Now we learn that it is interested in the growth of cities, slums, wild animals and some 400 other things. . . .

You've got to hand it to Uncle Sam. . . . The man who rules on whether or not our young diplomats may marry a snappy Latin or a buxom German is a 76-year-old bachelor. . . .

The only thing, we can figure in this new order barring foreign brides for our diplomatic employes is that they've got to see America first. . . .

Over there a man makes $1 a day, raises a family of six children and retires at 60 with enough saved to live comfortably. . . . Over here he makes $6 a day, drives a car to work, and when he finds he hasn't saved any money tells his wife the boss is a robber and isn't paying him enough. . . .

With "lay-down" strikes and "sit down" strikes all the vogue some enterprising fellow is going to figure that now is the time to make a "sleeping-on-the-job" strike popular. . . .

A few months ago we heard about a new machine that could do everything but think. . . . Now an inventor comes forward with one he insists can even think. . . . Well, no matter how many are sold, it's one machine that won't throw many people out of work. . . .

Now that Vice President Garner is an honorary doctor of laws maybe he is going to take a hand in doctoring some of those laws that need it so badly. . . .

You've got to take your hat off to Henry Morgenthau. . . . He's put the Government into the hot dog business. . . . While an annex to the Bureau of Engraving is being built during the next year he rented a 20-foot section of sidewalk to a hamburger merchant. . . . The Government will collect $10 a day—$3,560 a year rent. . . . All we need is a couple thousand Morgenthaus in the Government and the budget would be balanced in no time. . . .

Ship's reporters asked J. P. Morgan the other day when he returned from England what he thought about the European situation. . . . "I don't think," he snapped. . . . What a prospect for one of the Federal agencies in Washington! . . .

One thing is sure. . . . Those Americans who refuse to leave Madrid certainly don't care about their social security pensions. . . .

The American TUNGSTEN Industry

Above—Milling Plant of the Nevada-Massachusetts Company at Mill City, Nev. Capacity of Mill, 250 Tons per Day.

Right—Tungsten Prospect Near Sodaville, in Southwestern Nevada, Showing About 10 Feet in Width of Ore.

Lower Right—Silver Dyke Tungsten Mine Near Mina, Nev.

By CHAS. H. SEGERSTROM*

IN the United States the great mass of tungsten ores come from the Western States. Some ore has been found in the Eastern States, however, there is a serious question if any of these deposits are of economic importance.

Tungsten ores are found in all the Western States with the exception of Wyoming. Those of economic importance are found in Alaska, Arizona, California, Colorado, Idaho, Missouri, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah and Washington, while the local deposits as reported in the Eastern States are in Connecticut, Pennsylvania, Texas and North Carolina.

Tungsten does not occur in its elemental form in nature. Its compounds are among the rare minerals, and according to H. S. Washington, the average proportion to tungsten in the earth's crust is less than the estimated amount of silver in the same crust. H. A. Roland has classed tungsten with the elements, whose presence in the sun is doubtful.

Associated Rock. — Tungsten deposits are almost invariably in or associated with granitoid rocks, that is, rocks resembling granite in texture. The only known exemptions being their rare occurrence with quartz porphyries, just as tin is found in a few places with rhyolites.

Tungsten minerals are known only in connection with the lighter colored igneous rocks that contain considerable free quartz. In some places tungsten is found in veins cutting sedimentary rock, where the connection with igneous rocks may not be readily apparent. Deposits of tungsten, like those of tin, are connected with the upper and outer part of intrusive masses of granitoid rocks, so that if a considerable thickness of the rocks has been eroded, the deposit may have been removed, and this may account for the absence of tungsten in the neighborhood of some of the great granite masses. On the other hand, the rocks of the earth vary considerably in composition from place to place, so that the different kinds of ore deposits are unequally distributed.

Forms of Deposits. — Tungsten deposits may be grouped into five classes:

First.—Veins.
Second.—Pegmatites.
Third.—Replacements.
Fourth.—Contact—Metamorphic Deposits.
Fifth.—Placers.

Veins.—Veins are relatively thin tabular bodies that fill cracks in rocks and are deposited from solutions. Most of them are different from the rocks that form their walls, such as the familiar quartz and calcite veins.

All of the tungsten minerals have been found in veins, and most tungsten deposits are of this sort. The gangue is commonly quartz, which in many places carries some muscovite, especially along the walls. Many scheelite-bearing veins contain a greater or less quantity of calcite, iron, magnesium, manganese and fluorite. Nearly all tungsten-bearing veins carry pyrite, and in many it occurs in large quantities.

Some scheelite veins have been very rich. Hand-picked ore has been shipped from several mines in California, Colorado and Nevada. Some of this ore has averaged from 35 percent to 60 percent WO_3. However, such rich wolframite veins are unknown, although they may contain rich pockets. In the wolframite mines the tenor of the ore is usually from 1 percent to 1¼ percent WO_3. This is particularly true of the veins in China.

All tungsten veins are probably closely

*President, Nevada-Massachusetts Co. Presented to Metal Mining Convention, Western Division, American Mining Congress, September 28, 1936, at Denver, Colo.

related to replacement deposits, as certain tungsten-bearing deposits have the characteristics of both veins and pegmatites. The scheelite vein that occurs near Oreana, Nevada, like pegmatites, carries beryl, feldspar and mica.

Pegmatites.—Pegmatites accompany many quartz-bearing granite rocks, and are free from silica. They are quartz rocks having the form of lenses, veins, dikes or pipes. They are usually very irregular in texture and the mass of certain minerals may be very large. They have usually undergone changes through successive replacement of their minerals by the hot solutions accompanying or immediately succeeding the intrusion of igneous rocks and many pegmatites carry rare minerals, among which may be tungsten, that has been brought in by these solutions.

Pegmatite deposits are therefore a variety of replacement deposits. If tungsten minerals are present, they are invariably very late, and were deposited as the solutions were cooling down. Wolframite has been found in small quantities in pegmatite deposits southeast of Hill City, S. Dak., and North Croton, N. H. As would be expected, from the fact that pegmatites are formed largely from solutions, they grade into bodies which have the characteristics of both pegmatites and veins, as already mentioned.

Replacements.—When veins are formed in easily soluble rocks, the vein-making solutions, most of which are hot, commonly dissolve part of the rock and deposit in its place minerals, some of the elements of which may be entirely new, but the new elements generally combine with part of the elements in the original rock to form new minerals. Thus, in the replacements of carbonate rocks, tungsten is almost invariably combined with calcium, forming scheelite, however, the wolframite deposits near Lead, S. Dak., are prominent exceptions.

The change in composition and crystallization may be so complete and extensive as to obliterate all traces of the original opening through which the solutions traveled. Such bodies of altered rocks may carry tungsten and other valuable elements, and are naturally called replacement deposits.

Certain rocks are much more easily dissolved than others in the solution from which tungsten and other minerals are deposited. Rocks that are largely or wholly made up of carbonates, such as limestone, dolomite and iron carbonate, are particularly soluble. Other rocks are also more or less readily soluble in certain types of solutions. It may be generally considered, however, that an extensively replaced sedimentary rock was probably a rock containing a large percentage of carbonates. The wolframite deposits formerly worked by the Homestake Mining Company and the Wasp No. 2 Mining Company at Lead, S. Dak., were replacements of a dolomite bed, and some of the rich ore still retained the Cambrian shells which were enclosed in the dolomite.

Replacement deposits in limestone differ from contact-metamorphic deposits, having a very much simpler assembly of minerals, mostly recrystallized calcite, quartz, pyrite, and the tungsten mineral.

Pegmatites.—Pegmatite pipes—crooked, irregularly cylindrical bodies of pegmatite in granite rocks—are another form of replacement deposits. Pipes carrying scheelite in the Deep Creek Mountains of Utah, were mined during 1916, 1917 and 1918 in a small way.

Contact-Metamorphic Deposits.—When the granite or other closely related rock is forced into other rocks it is accompanied by hot water that is squeezed out of the mass, and the water is loaded with mineral matter in solution. It always carries quartz, and may carry sulphur, iron, aluminum, copper, bismuth, potash, sodium, phosphorus, fluorine, boron, tungsten and other elements.

The solution always attacks the country rock and will attack limestone or dolomites with special vigor. Part of the rock is dissolved and carried away; part is re-crystallized, and a third part, especially if the country rock is impure, will form new minerals by combining with the elements carried in the invading solution. Thus if the solution happened

Surface Tungsten Deposit Near Ely, in Eastern Nevada.

to carry tungsten, it combines with the calcium of the rock and oxygen to form scheelite, which, as already has been said, is almost invariably the tungsten mineral found in deposits in a limestone or dolomite country rock.

Because the alteration is commonly found at the contact with the intrusive, rocks so altered are called contact-metamorphic rocks, and the volumes so altered are known as zones, because they usually form more or less irregular bands around the intrusive mass.

Not only are limestone and dolomite metamorphosed by the heated waters issuing from or with the intrusive mass, but the intrusive itself may be altered, though in less degree, by the introduction of other compounds, including lime taken by the water from the surrounding rocks. Intrusive rocks so altered are said to be automorphosed.

Such deposits are, of course, only an extreme variety of the replacement deposits, and the replacing aggregate is known as *contact-metamorphic deposits.*

These deposits are ordinarily composed of quartz, garnet, calcite, tremolite, hornblende, epidote and other nonmetallic minerals, with which may be pyrite, magnetite, molybdenite, chalcopyrite and rarely bismuth. *Scheelite* is invariably the tungsten mineral found in such deposits. It is distributed through the rock and may occur in grains, ranging from 1-250th of an inch to several inches in diameter, but the grains are generally less than one-quarter of an inch in diameter. Very large bodies of ore carrying about 1 per cent tungsten trioxide WO_3 and some ore, as heretofore stated, carrying as much as 40 to 50 per cent have been found.

Placers.—Tungsten minerals are resistant to solutions and oxidization by natural agencies so that as the country rock and veins are worn down by weathering, the tungsten minerals accumulate in debris, as does gold. Tungsten minerals, however, are very friable, and rapidly grow finer as they move down the valley slopes toward the stream beds. When they are thus finely divided the surface area exposed to attack is greatly increased, so that the minerals are more readily weathered and the more soluble and friable. Hydrous oxide WO_3 H_2O forms and is washed away. For this reason tungsten minerals are rarely found in the stream beds themselves and are unknown in streams of any considerable size, unless enclosed in quartz. There are considerable deposits of tungsten in placers near Atolia, Calif., also in certain portions of Arizona.

Distribution of Tungsten Deposits in the Western Portion of the United States

The Rocky Mountain Region

Colorado.—The principal group of tungsten deposits in the Rocky Mountain area lies around Nederland, and between Nederland and Boulder, in Boulder County, Colo. Before 1918 this was one of the richest fields known. Tungsten mineral is ferberite (FE WO_4) which occurs in veins, most of which have proved to be small, with rich shoots of ore. A great deal of prospecting has been done both in and around the field. The veins are largely made up of a very fine grained quartz called "horn rock" through which the ferberite is distributed. Much of the mineral is in very small grains, some of which are less than .002 inch in diameter. Concentration is therefore difficult and concentrates may carry less than 50 per cent WO_3, although most of the concentrates carry 65 per cent WO_3. In some of the ores a considerable amount of phosphorus is present. Production is now going on in this field. The *Wolf Tongue Mining Company* is the leading operator.

Wolframite has been found in the molybdenite at Climax, a few miles northeast of Leadville. Scheelite was found in the silver deposits at Leadville, and some in a highly altered limestone near Salida. Hubnerite was found north of Silverton, San Juan County, and in several veins from which a small production was made in 1918. Hubnerite was also produced from a vein at Ophir.

Plant of Boriana Mining Company at Yucca, Ariz.

South Dakota.—There were two main deposits in South Dakota, one adjoining the Homestake Mine and the other 2½ miles south of Lead, at the Wasp No. 2 Gold Mine. Wolframite was brought up by hot water and replaced a comparatively flat-lying dolomite in both places, and the ore also carried some gold. These deposits yielded about 2,000 tons of tungsten concentrates, and according to last reports are now probably exhausted.

Hubnerite was also found in a small quantity in Two-Bit Gulch, about two miles southeast of Deadwood, and occurs in tin oxide near Hill City, 55 miles south of Deadwood. According to the latest information, no considerable mining of tungsten is going on in South Dakota.

New Mexico.—In New Mexico, wolframite was mined northeast of Elizabethtown, on Willow Creek, in Taos County, and some near Gage, Luna County. Hubnerite was also mined near Whiteoaks.

Idaho.—The Idaho hubnerite was mined at Patterson, Lemhi County, from a quartz vein. It is said that this vein carries ore about .5 WO_3. Scheelite was also found in gold veins near Warren. A considerable quantity was also mined in quartz veins on Tungsten Mountain, five miles from Copeland. In 1916 scheelite was mined at Murray, where it occurred with lead and gold in the Golden Chest Mine; also in the Winnie May Mine and the Mother Lode Mine on Pritchard Creek, and in Pony Gulch. Ferberite has been mined on Corral Creek, Soldier Mountain, Blaine County, and wolframite was also found on Granite Mountain, near Martin, Butte County.

Montana.—In Montana hubnerite was found in the Birdie Mine, northeast of Butte, and in several of the copper veins at Butte; also at Pony and near Anaconda.

A considerable amount of scheelite has been mined at Jardine from quartz veins and quite a number of shipments have been made from this property. It has been a by-product of the gold and arsenic production. Late reports show the property in active production. A little scheelite was produced at Libby, also from the Midas Mine, about 36 miles southeast of Libby.

Washington.—On the western slope of the Rocky Mountains, wolframite in considerable amounts has been found in veins, and in greisen, on Grouse Mountain, near Deer Park; also at Deer Trail (nine miles southeast of Fruitland), and a considerable production has been made from all these deposits. The property operated by the Tungsten Producers, Inc., has recently been sold to the General Electric Company, who are working it as a source of supply of tungsten for lamp filaments. This is due to the fact that the ore is remarkably free from molybdenum. It is expected that within the next few years considerable activity in this district will take place.

A little scheelite has been found at Lead Point, a few miles southeast of Northport, in Yakima County, and at Goose Prairie.

The Great Basin Region

Between the Rocky Mountains and the Sierra Nevadas lies the Great Basin. It contains the greatest number of tungsten deposits in the entire country. In this region limestone is widely spread, and there are a great number of intrusions of related granite rocks, such as quartz monzonite, granodiorite and others, and the entire region is deeply and widely underlain by a batholith, from which the intrusions are protuberant and are younger than the limestones. As a result of these intrusions, there has been formed a large number of contact-metamorphic deposits, veins and pipes carrying scheelite; a few veins carrying hubnerite and other veins carrying wolframite.

Utah.—In Utah, contact-metamorphic deposits are found in Box Elder County, about 15 miles northeast of Lucin, and these produced some concentrates during 1917 and 1918. Near Gold Hill, in the Deep Creek Mountains, quartz monzonite has yielded some scheelite. Near Trout Creek several scheelite-bearing veins of small size were found. Also, wolframite was found in the mountains near Beaver.

Nevada.—In the Snake Range, Nevada, just west of the Utah line, numerous tungsten deposits have been discovered. At Osceola, there are many tungsten replacement deposits of limestone. On the west side of Wheeler Creek, hubnerite and quartz veins, with some scheelite, have been mined. Southward, on the east side of the range, scheelite was found in quartz veins at four or five places along Snake Creek, also at a point five miles south of Snake Creek, and in a score of places along Lexington Canyon, which is located 16 miles southwest of Garrison, Utah. Here, part of the deposits are replacements of limestone; some of them are calcite veins and others lie in narrow quartz veins bordered by mica. Most of these deposits produced tungsten during 1916-1917 and 1918 when concentrates brought $25 to $100 per unit.

On the west side of the range, near the entrance to Sacramento Pass, seven miles north of Osceola, scheelite was found with gold in the replaced limestone. In a replacement deposit on Pea Ridge, two miles south of Osceola, on Willard Creek, considerable tungsten was produced. Scheelite was produced at Shoshone in a quartz calcite vein cutting the limestone.

A considerable number of hubnerite veins were found on Wheeler Peak and produced several hundred tons of concentrates during 1916-1917 and 1918, while south of the Snake Range a little wolframite has been found, near Panaca.

Connecting the Snake Range and the Shell Range, about 30 to 40 miles north of Osceola, is a range of the Red Hills. In these hills 15 or 20 quartz veins have been found that carry hubnerite, and some ore was produced during 1917-1918. This locality was known as Tungstonia. On the west and northwest of the settlement of Cherry Creek, about 50 miles northwest of Tungstonia, are several small scheelite veins in limestone, and some hubnerite veins that cut the granite.

In my opinion, this entire district gives no great promise of any tungsten production at present prices, although a good tonnage could be profitably produced, providing tungsten sold for $20 to $25 per unit.

Farther north no tungsten is known until one gets about half way across the state of Nevada to the Hot Springs Range, about 20 miles north of Golconda. Here, contact-metamorphic deposits carrying about 1 per cent WO_3 have been found; also scheelite veins in Paradise Valley, about 45 miles north of Winnemucca. Southward from Winnemucca there are many contact-metamorphic deposits, one of the best known being that of the Nevada-Massachusetts Company, Mill City, in the Eugene Mountains.

This deposit has been unique as to depth and continuity, and probably more remarkable from the fact that thin limestone beds, three to six feet thick, have been turned vertical by granite intrusions, and in spite of this disturbance, they are so continuous that they have been followed to a depth of over 1,000 feet, and for a length of more than 3,000 feet.

The ore averages about 1 per cent WO_3, although there have been places which have averaged up to as much as 10 per cent WO_3.

At Nightingale is a very interesting deposit of tungsten in the same formation as Mill City. This property is owned by J. G. Clark and associates, of Boulder, Colo. There is a well-established camp with a mill having a capacity of 150 tons per day. The property is favorably located and it should have a considerable production.

An unusual scheelite deposit has recently been discovered near Oreana. The ore is very high grade. Two cars of 45 per cent WO_3 ore were hand sorted and shipped. A great deal of ore is on hand, ready to be milled, that averages 8 per cent WO_3. The scheelite is associated with beryl, quartz, feldspar and mica, and approaches pegmatite in composition. The veins can be traced for a distance of over 5,000 feet, and this district may prove to be an important one. The property is operated by the Rare Metals Corporation of New York.

Wolfram was found at Round Mountain, also hubnerite, near Ellsworth. Scheelite prospects have been worked in a score of places in this district. Near Gardnerville, a prospect is being developed, and at Rand, near Cottonwood, and also at Rawhide, deposits of considerable size have been found.

In the Sodaville-Mina district and in southern Nevada, there are scores of prospects, all of which give some promise of future production. These prospects and mines are almost too numerous to mention in this paper; however, this district may prove to be one of importance in the matter of future production. It extends into California, near Bishop.

California.—The two principal tungsten districts in California are those near Bishop and Atolia. At Bishop the deposits are contact-metamorphic, and have been of commercial importance and contain large reserves of ore. One of them is reported as now being reopened by the Union Carbide Company of New York, and active developments appear to be under way.

At Atolia, the property owned by the Atolia Mining Company has been one of the best producers in the world, although its production is now exceeded by the scheelite-producing mines at Mill City, Nevada. The ore bodies reached a depth of 1,400 feet, and undoubtedly extend considerably deeper. The production from these properties came at a time when tungsten was sold at its highest point, and a great deal of concentrates were sold at around $100 per unit. Vigorous development and operations still continue on this property.

Just west of these properties, placer mining is being exploited by the Atolia-Rand Mining Company to produce scheelite from the placers. Water has been pumped from the wells at Cuttleback Lake and a large tonnage of placer is handled daily. It is estimated that 20,000,000 yards are available for treatment and that there is recovered about one pound of tungsten per cubic yard.

There are also deposits near Victorville; ore was found near Nipton and in the Rand Mountains, also near Kernville, Posey, and Glenville, in Kern County, and in Upper Kings River Canyon, in Fresno County. Considerable scheelite was also found in the gold veins in the Union Hill Mine, near Grass Valley, in Nevada County, as well as in the Dipper Claim in the Alleghany district.

Arizona.—In Arizona, the Boriana Mining Company, near Yucca, has been the principal producer and active development and shipments are under way. The property is well equipped and the concentrates contain both scheelite and wolframite, and it is one of the most important in domestic production.

Wolframite also was found at Cave Creek, 30 miles northwest of Phoenix, near the Hot Springs, and in Bradshaw Mountains, west of Tucson. Hubnerite also has been mined near Dragoon Mountains.

An important producer is located near Las Guigas Mountains. This property is equipped and has produced considerable ore, and while the ore has a high manganese content, it contains no trace of molybdenum. It therefore has been purchased by the General Electric Company for the purpose of making lamp filaments, and will probably be developed to its fullest extent.

Scheelite was also mined in several other places at Oracle, near Prescott.

Oregon.—Scheelite has been reported from the Cliff Mine, near Sumpter, and near Joseph, Oreg., there is a contact-metamorphic deposit. No ore of commercial value has been shipped; however, there are several locations which give exceptional promise.

Alaska.—A few small deposits have been found in Alaska, and considerable scheelite in placer was found at Nome, near Deadwood Creek, and near Circle. Although a few tons of concentrates were produced in 1917-1918, no deposits of consequence were found. This may be due to the fact that the country is rather hard to prospect.

I hope this long review has not worried you. My reason for describing properties in some detail is that I wanted to emphasize the importance of the

Tungsten Prospect Near Oreana, Nev., Showing Ore Piled at Entrance to Tunnel.

Tungsten Industry in America, and that we have reserves in the western states that can be developed. These areas contain deposits of commercial value.

Properties of Tungsten and Its Uses.—I have been asked to review some of the properties of tungsten, those which make it so useful, and note in passing that some of these properties are out of all proportion to the quantity consumed and to its cost.

Tungsten is a metallic element, like iron, gold, lead, copper, and other well-known metals. Chemically, its relationship is close to chromium, molybdenum, and uranium. Only three metals have a specific gravity as high, namely, platinum, iridium, and osmium. The melting point of tungsten is 5,913° F., and is higher than that of any other metal, except rhenium, and is so high that the metal has been melted only a few times, and then only in an experimental way.

When drawn into wire, tungsten is said to have a tensile strength of 600,000 pounds to the square inch, while that of the best steel is about 400,000 pounds to the square inch. No other metal produced in such small quantities has the industrial importance or has such an

New Milling Plant of Rare Metals Corp. at Toulon, Nev.

influence on the comfort of the people at large as tungsten.

In 1928 it was estimated that to have produced the artificial light used in the United States during the preceding year with the old carbon filament lamp, which lamps the new tungsten filament lamps have superseded, would have necessitated an additional expenditure of $2,000,000,000. In that year nearly 500,000,000 lamps of all types were sold. In 1934, about 700,000,000 lamps of all types were sold in this country, so that presumably the saving in 1934 was increased to more than $2,500,000,000. Yet, for all these uses in lamps, not more than 100 tons of concentrates were used per year.

Most of our tungsten, however, is used in tool steel and high-speed steel industry, and here, although not so readily noticed, the savings in time, labor, machinery and investment of funds, has been nearly as great.

For example: *One* man with *one* lathe using high-speed *tungsten steel tools* can do as much work as *five* men with *five* lathes using the old *carbon steel tools.*

A manufacturer making a medium-priced car recently said that if he had to use the old carbon steel tools, he would have to increase the cost of each car more than $200. Thus in building 4,000,000 cars annually in this country, if the saving were only half as much, it would mean an annual saving of over $400,000,000, in addition also, the extra cost for machinery and housing, which amount is uncertain, however, probably the saving would be as much greater.

In the petroleum and gas industry, through the use of bits, made up with hard tungsten carbide alloys, they are drilling farther and making great savings, as these bits last from two to ten times as long as those which were not treated. An excellent authority states: "Today no oil operator who considers efficiency and economy will permit the drilling of wells without the use of hard-surfacing metals, especially where deep holes are required."

Probably the total saved by the use of tungsten in this country is not less than $3,000,000,000 to $4,000,000,000 annually. In addition to this, the use of tungsten permits the manufacture of innumerable conveniences, comforts, and luxuries, including radio tubes, electrical contacts, aeroplanes, and automobile valves, phon-

(*Concluded on page* 63)

Climax, Colo.

MOLYBDENUM Operations at Climax

By WILLIAM J. COULTER*

A Portion of Residential District.

MOLYBDENITE is molybdenum sulphide, and it is in this form that molybdenum principally occurs in nature. It is not a rare mineral, as many believe, but on the contrary it is widely distributed over the earth's surface and is commonly associated with eruptive rocks, particularly pegmatites. Concentration of molybdenite in commercial quantities is a different matter, however, and there are only a few known producing deposits.

Colorado has the largest known deposit of molybdenite in the world at Climax, and from this deposit the molybdenum market receives approximately 75 per cent of its supply. Other producers of molybdenum, in their order of importance, include Green Cananea in Mexico, Copper Creek in Arizona, Questa in New Mexico, Knaben in Norway, and a small property in Morocco. These few deposits account for over 98 per cent of the present world production. A small quantity of molybdenite comes into the market as custom ore from a few scattered high-grade pockety deposits, but this is neither an important nor a dependable source. From one consistent producer in Arizona a small amount of molybdenum is being recovered from wulfenite, lead molybdate. Molybdenite occurs in small quantities in the ore body of the Utah Copper Company, in Bingham Canyon, and it is understood that experimental work is now being done that may lead to a partial saving of a portion of it as a bi-product, which opens the possibility of another important producer of molybdenum.

Ore reserves in excess of 100,000,000 tons, averaging .8 per cent molybdenite, have been developed at Climax by diamond drilling and development work. The known mineralization area has not been fully explored, and indications from a diamond drilling program now under way are that the above ore reserves will be substantially increased.

The ore body occurs around the border of a highly-altered and silicified granite core, in pre-Cambrian rocks, and in the upper horizon forms a continuous ring or band that varies from 250 feet to 500 feet in width. Recent diamond drilling and development work has shown maximum depth to the west, and in this section of the deposit the strong downward extension of the ore body has already been proven to a depth of 2,000 feet below the outcrop.

The ore body is intensely fractured, especially in the outer portion of the zone, and mineralization occurs principally in these fractures, but toward the core, where silicification has been more complete, the molybdenite is finely disseminated in a silica matrix. Mineralization fades out gradually on both the foot wall and hanging wall, and commercial mining limits are determined on assay values. Within the mining area above the Phillipson level, values are surprisingly uniformly distributed, and there are but few inclusions of waste or dykes to contend with.

Sericite seams along fracture planes are common, and as a result the ground within the ore body is characteristically weak and will not stand without support when opened up to any extent. This

* General manager, Climax Molybdenum Corp.

fact, together with uniformity of mineralization, absence of barren inclusions, and width of ore body, offers exceptional opportunities for cheap, large-scale mining, and full advantage has been taken of these factors in selecting the mining system.

The mine is opened up by three adits, but work at the present is confined principally to the Phillipson level. The average vertical height of ore over this level is approximately 400 feet, and ore reserves in the block are estimated at 60,000,000 tons of recoverable ore from above the level. A vertical exploration shaft 500 feet deep has been put down in ore from the Phillipson level in the western section of the ore body, and a small amount of diamond drilling and drifting has been done. The purpose of this work is to outline the ore zone on the lower level and to further explore the deposit in depth by diamond drilling. Production from this level is, therefore, a number of years in the future.

Briefly, the mining method selected is an induced caving system, and while original and unique in many respects, it is in reality a combination of the systems employed by the Miami Copper and the Alaska Juneau. The ore is cut off on the hanging wall, foot wall and mining level, and powder pockets are blasted at regular intervals in the ore body above the mining level. As the ground is heavy, the cut-off work consists principally of drifts and raises, and the pillars between them are drilled for blasting in a final big shot. Coyote drifts are driven at vertical intervals of 30 feet above the mining level, and powder pockets are placed from these drifts. After a given area has been prepared in the above manner, all supporting pillars and the powder pockets are blasted electrically with delayed caps. Controlled drawing of the ore then follows. The first big shot above the Phillipson level involved an area approximately 250 feet square. One hundred and ten thousand pounds of powder were used, and 750,00 tons of ore were recovered. The idea in this shot was to undercut an area of sufficient extent to permit caving to go through to the surface and avoid possible arching, but 15 subsequent shots have been much smaller.

Haulage drifts 12 feet wide and 9 feet high are driven along the hanging wall and foot wall of the ore body, and these are connected with cross drifts at 100-foot intervals. In the cross drifts, chutes located opposite each other are spaced 100 feet apart. Two branch raises from each chute go up to grizzlies laid out on 50-foot centers on the grizzley level 60 feet vertically above, and a rock raise is driven up from each end of a grizzley to the mining level 45 feet higher.

Ore coming to the chutes passes through grizzley bars spaced for a three-foot opening. The chutes are of very rugged construction; the width of the opening at the cap is six feet; they are steel lined, and the flow of ore through them is controlled by air lift finger gates. The ore is loaded into 10-ton Granby-type cars, and 25 of these cars make up a train. The average length of haul to the crusher bins is 6,000 feet, and each train is handled by a 19-ton trolley locomotive. The locomotives and cars are equipped with Westinghouse air brakes.

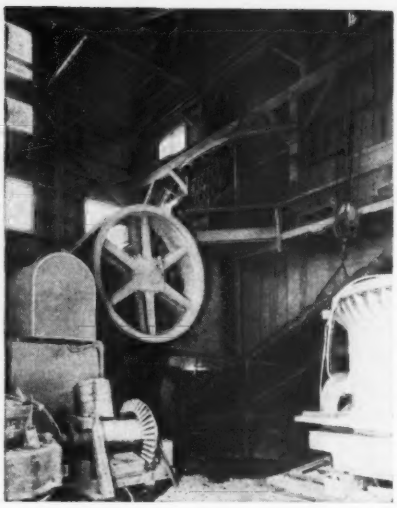
Two crushing units, with a capacity in excess of 15,000 tons per day, reduce the ore as it comes through the grizzlies to a minus 5-16-inch mill feed. In the No. 1 unit the ore is fed to a 48-inch x 60-inch jaw crusher by a Ross feeder, and reduced to a maximum of 12 inches in diameter. Secondary crushing is done in a standing seven-foot Symons cone crusher, where a reduction to a maximum of 1½ to 2-inch product is made. The discharge from the standard crusher is then screened, the oversize is in closed circuit with two seven-foot short head Symons cone crushers, and the undersize goes directly into the mill bins. The No. 2 crushing unit has double the capacity of the No. 1 unit, and the flow sheet and equipment are the same. In the No. 1 unit it has been found that additional fine crushing capacity is required to balance the other crushing units, so that in the No. 2 unit provision was made for five seven-foot short head crushers instead of four.

Allis-Chalmers Packing Machine.

The mill has a capacity in excess of 10,000 tons per day. Both tonnage and recovery are a function of grind. For finer grinding and a 90 per cent recovery, the mill is rated at 10,000 tons per day, while on a coarser grind and an 80 per cent recovery it has a rating of 15,000 tons. The first method of operating is the most economical, and the second method gives maximum production. The No. 1 section was built in 1917 and is being run on the original flow sheet. Two-stage grinding is done in three 6 ft. x 6 ft. mills and two 6 ft. x 10 ft. mills with elevators and classifiers working between the primary and secondary units. The No. 2 section is made up of seven 9 ft. x 9 ft. ball mills and each mill is in closed circuit with a 78-inch duplex high-weir type Akins classifier. The circulating load is maintained at between five and six to one. The classifier overflow in each unit is treated in Climax mechanical flotation machines, where a rougher concentrate is made. The flotation feed runs between 30 per cent and 35 per cent plus 100 mesh, and the rougher concentrate averages around 35 per cent MoS_2. This product from both mills is sent to a common regrind unit, where it is ground to minus 200 mesh in an 8-foot x 20-foot pebble mill, working in closed circuit with a classifier. The overflow of the classifier is treated in two banks of mechanical flotation machines and is subjected to four stages of cleaning. A final concentrate averaging 90 per cent MoS_2 is made. The finished concentrate is then thickened, filtered, and dried to

Above—Ingersoll-Rand at Climax.

Left—Main Haulage Phillipson Level.

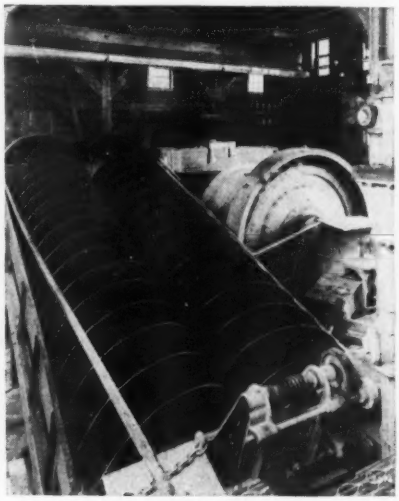


Buchanan Jaw Crusher and Ross Feeder.

3 per cent to 4 per cent moisture on Lowden dryers in a plant made up of three units outside of the mill building. The dried concentrate is stored in bins, from which it is drawn and packed in either barrels or sacks by an Allis-Chalmers flour packing machine. All foreign shipments are made from the plant in barrels, while domestic shipments are made in paper-lined jute sacks.

Domestic shipment of concentrate is made to Langeloth, Pa., where the concentrate is converted into calcium molybdate and ferro-molybdenum, in which forms it is added to steel and iron as an alloy. Similar conversion plants are located at various places in Europe.

Molybdenum is one of the industry's most versatile alloys, and the addition of small amounts to steel and iron produce remarkable changes in their characteristics and physical properties. Molybdenum toughens, gives a higher tensile and transverse strength, greater impact and fatigue strength, increases wear resistance, and aids machinability. In iron, its application has been proven and adopted in cam shafts for automobile engines, clutch plates, gears, ball mill liners, pug mill knives, steam hammer frames, high temperature steam valves, bases and housing for pumps, and various heavy-duty machines, such as cold headers and steel mill rolls. In steel, molybdenum is found in the better quality crank shafts, propeller rods, large forgings, machine tool parts, gears, shafts, arbors, and hundreds of similar parts. It is widely used in combination with other alloys, as nickel, manganese, and chromium, particularly in steel for a broad and varied number of products. Aside from an alloying element in iron and steel, molybdenum is used extensively in its metallic form in the electrical field, and includes such applications as make-and-break contacts, lead-in wires for lamps, and radio tubes, radio tube grids, and plates and targets for X-ray tubes. It is used as a catalyst and as a mordant, and in chemistry forms the basis for a number of compounds used in pigment, dye, ceramic, rubber and leather production. The amount of molybdenum used in the above applications is expanding rapidly in both foreign and domestic markets, and new uses are constantly being developed. These facts, together with general business improvement, account for the rapidly increasing demand for molybdenum.



78-Inch Duplex Submerged Type Akins Classifier.

The capacity of the Climax plant is being increased this year from 4,000 tons per day to 10,000 tons per day, and is expected to be operating on the latter basis by December 1. All units of the mill have been completed and are now in operation. The No. 2 crushing unit and No. 3 drying unit are nearing completion.

Between 900 and 1,000 men will be steadily employed by this operation, and an extensive program is under way for their accommodation. The present hotel is being enlarged for 550 men, a large and completely equipped recreation building is under construction to house all of the various kinds of indoor sports for the community, a new, modern change house for 600 mine employes, with a solarium included in the equipment, is being built, a hospital, a mill change house, and mill office also are a part of the program now under way. More than 25 modern homes for families have been built within the last year, and more are under construction.

Since Climax is located near the top of the Rockies, at 11,400 feet, water for mill and domestic use has been a problem. This has been solved by building a storage reservoir of 2,000-acre feet capacity near Robinson, about three miles below Climax. The water supplying the reservoir is gathered by a system of canals, and is pumped back from the reservoir to the plant through a 20-inch pipe line.

Climax is located on a narrow-gauge branch of the Colorado and Southern Railroad operating between Denver and Leadville. The distance to Leadville is 12 miles, and to Denver 155 miles. A good state highway to both Denver and Leadville also passes through Climax.

Per Capita Debt

● PER capita debt in the United States, taking into account not only the debt of the Federal Government but also that of the various political subdivisions, totaled approximately $416 as of June 30, 1936. This compares with a total per capita debt of approximately $1,016 in the United Kingdom at the close of the fiscal year 1935.

This information and the facts that follow are from a study, "Public Debt in the United States and Abroad" made public by the National Industrial Conference Board.

The total public debt of the United States as of June 30, 1936, amounted to an estimated $53,400 million. Of this total the debt of the Federal Government accounted for $33,800 million, or 63 per cent, while state and local debt accounted for $19,600 million, or 37 per cent. On March 1, 1935, the latest date for which complete figures are available, the total public debt of the United Kingdom amounted to £9,491 million, or approximately $47,455 million. The national debt, comparable to the debt of this country's Federal Government, amounted to approximately $39,610 million, or 83.5 per cent of the total, while the debt of local political subdivisions amounted to approximately $7,845 million, or 16.5 per cent of the total.—*Metal Market.*

Council for Industrial Progress

The second meeting in 1936 of the Council for Industrial Progress, headed by Major George L. Berry, named as Industrial Coordinator of the Council, was held December 10 and 11.

The first session was devoted to a general meeting of those attending and addresses by Coordinator Berry, Senator Wheeler (Dem., Mont.), Congressman Rayburn, John Dickinson, assistant attorney general, and others. Attending the sessions in addition to several hundred representatives of labor and certain industries, were numerous Government department heads. The second day's sessions were executive in nature, consisting of discussion of legislative proposals laid before the meeting by its committees. Steps were taken at the second session to formulate the proposals into a legislative program which is to be submitted to the President as the "thought" of the Council. Committee reports indicated that some sort of legislation to replace the NRA is intended to be formulated but the exact legislative vehicle is yet to be worked out.

The POTASH Industry in the United States

By J. J. BOURQUIN*

THE history of the potash industry in the United States may be divided into five distinct and well-defined epochs. The events and circumstances characterizing the five epochs are summarized briefly in the following paragraphs:

EPOCH I
(*Colonial Times to* 1860)

Epoch 1 comprised the period from early Colonial times to the year 1860, during which period the manufacturer of potash from wood ashes occupied a position of prime importance and potash was an important commodity of export. This early American chemical industry suffered materially as a result of severe Federal restrictions on commerce occasioned by unpleasant international relationships between the United States, England, and France prior to the War of 1812. The development of a process (the Leblanc process) whereby sodium carbonate, Na_2CO_3 (soda) could be prepared cheaply from common salt (NaCl), and substituted for potassium carbonate for many industrial purposes served further to curtail the market for American potash derived from wood ashes. But the discovery of mineral potash in drilling for salt near Stassfurt in northern Germany in 1843, and the mining of potassium salts which began at Stassfurt in 1861, served more definitely to terminate the first period of the potash industry in the United States.

EPOCH II
(1861 *to* 1914)

Epoch II, which comprised the years 1861 to 1914, inclusive, was a period of almost complete and complacent dependence on Germany for potash required to satisfy the chemical and agricultural demands of the United States. The production of domestic potash declined to such insignificant figures that it may be said the country was without a potash industry worthy of the name. The great German potash syndicate was organized and was fostered by the imperial German government. The prime objects of the syndicate were to eliminate competition, to prevent over-production, and to promote propaganda for the expansion of domestic and foreign markets. The German "potash law of 1910" led to the cancellation of existing potash contracts favorable to American consumers, and occasioned great financial loss to American potash buyers. This German legislation aroused the United States Government to make a nation-wide survey of the fertilizer resources of the country, having potash in mind as the principal object of the survey. Special appropriations were made by Congress to the United States Geological Survey and the Bureau of Soils for researches relative to the possible presence of commercial deposits of potash salts in the United States. Field surveys and studies of the potash resources of the country were being actively pursued, and comprehensive scientific research into practical economic methods for the manufacture of potash from one or more of the several sources of raw materials which had been found was beginning, but, in the meantime, Europe had become involved in war. In January, 1915, Germany placed an embargo on the export of potash salts from Germany, and the United States suddenly was made dependent upon its own resources for this commodity of commerce.

EPOCH III—1915-1920
(*The World War Potash Industry*)

The period 1915 to 1920, inclusive, constitutes the third epoch in our history and this chapter treats of the World War potash industry in America. Stocks of imported potash salts in the United States at the time of the declaration of the German embargo soon were depleted and in keeping with the old-established economic law of supply and demand, the price of potash on the American market climbed quickly to unprecedented figures. High-grade agricultural salts, which previously had sold at a normal price of $35 to $40 a ton, were quoted at prices ranging from $350 to $425 a ton in April, 1916. Construction of the majority of the war-time potash plants was inspired entirely by the unprecedented prices of potash. It was generally realized that the prevailing demand and prices probably would be of short duration, and capital rushed into the potash industry in anticipation of great profits to be made quickly. Production and the time element appeared to be the all-essential factors of success. Production costs were of secondary importance and there was too little opportunity for scientific research.

Although the World War potash industry of America struggled heroically for existence following the armistice of November 11, 1918, it may be said to have practically died in 1920, when importation of low-priced potash from Germany were resumed. Financial losses sustained by the World War potash industry amounted to millions of dollars.

EPOCH IV—1921-1930

During the period 1921 to 1930, the United States returned practically to a condition of dependency on foreign lands for supplies of potash. Official Government records indicate that the amount of potash produced in the United States did not equal 20 per cent of the potash imported into the country during any year in the period cited. Popular interest in a possible domestic potash industry declined, nevertheless the American Trona Corporation (now the American Potash and Chemical Corporation) operating at Searles Lake, Calif., extended its chemical research, improved its process, enlarged its capacity, and became the principal potash producer in the United States, a position which it apparently still holds. Congress, however, continued appropriations to be expended "for exploration and investigation within the United States to determine possible sources of potash, nitrates and other natural fertilizers," and "for the purpose

* District mining supervisor, U. S. Geological Survey, Denver, Colo.

of determining the location, extent and mode of occurrence of potash deposits in the United States," and the United States Department of Agriculture, the United States Geological Survey, and the United States Bureau of Mines continued field investigations and research work which had been initiated by Congress in 1911. During a period of many years, geologists had held that the Permian salt basin of Texas and New Mexico was a promising field for the discovery of a subterranean deposit of potash salts. Traces of material evidence of soluble potassium salts in this basin were reported in 1912. Drilling for potash in the basin was begun in December, 1915, by the United States Geological Survey. The first discovery of the mineral, sylvite, KCl, in the Permian basin was made in cuttings from the McNutt No. 1 oil test, drilled by the Snowden and McSweeney Company in February, 1925, under the direction of the late V. H. McNutt, a geologist, of San Antonio, Tex. This discovery gave impetus to prospecting by drilling methods in the Permian basin by the Government. Twenty-three core tests were drilled in the basin during the ensuing five-year period with funds provided by an Act of Congress. The Snowden and McSweeney Company, keenly interested in the possibilities of prospecting for potash, also embarked upon an intensive core-drilling program. Organization of the American Potash Company was effected and this company continued the program of prospecting which had been initiated by the Snowden and McSweeney Company. The minerals, sylvite, polyhalite, langbeinite and carnallite, were found in many of the core tests; the continuity of the bedded deposits was reasonably well established and, in December, 1929, sinking of the No. 1 shaft by the American Potash Company was begun. The shaft was completed in January, 1931. The first commercial production in the United States of the potash mineral, sylvite, was made on March 7, 1931, and hence, although the output of potash from this mine during the ensuing year was not great, the writer views the production of March 7, 1931, as marking the beginning of another epoch, the fifth, in the history of the potash industry in the United States. Moreover, and of far greater importance, it marked the beginning of the complete emancipation of the United States from dependency upon foreign lands for potash, though this had been foreshadowed by the developments previously noted at Searles Lake, Calif.

The name of the American Potash Company was changed to the United States Potash Company in 1930, and shortly thereafter the Pacific Coast Borax Company, formerly interested in the production of potash at Searles Lake, Calif., acquired an interest in the properties of the United States Potash Company.

Epoch V—1931-1936

The period 1931 to 1936, inclusive, which appropriately may be designated as the fifth epoch of the potash industry in the United States, has been characterized by continued prospecting for potassium salts in the Permian basin in New Mexico and elsewhere, rapid development of potash mines for the production of high-grade potash salts in New Mexico, a tremendous increase in refinery capacity for the production of potassium muriate from the brines of Searles Lake, in California, a continuously increasing production of both crude and refined potash salts, and the inauguration of a potash export business which has involved shipments of potash salts to at least 22 countries throughout the world.

Views from Properties of the U.S. Potash Company

A second mine shaft was completed by the United States Potash Company in June, 1933, and the mine has been developed to produce in excess of 100 tons of crude salts an hour.

Construction of a refinery by the company was begun in April, 1932, and was completed in September of the same year. Commercial production of muriate was begun on September 17, 1932. The refinery capacity has been increased materially since that date, however, and is now equipped to deliver 400 tons of high-grade muriate a day, or approximately 150,000 tons a year.

The Potash Company of America, the second company to enter the New Mexico potash field, began prospecting in 1931, proved the commercial value of deposits of potash salts underlying lands which the company controlled, began sinking its No. 1 shaft in February, 1933, and completed the shaft in December of the same year. Sinking of a second shaft was begun by this company in October, 1934. The No. 2 shaft had not been completed by September, 1936. The Potash Company of America made its first shipment of commercial potash in the form of manure salts on February 20, 1934. A refinery was erected later and the company began marketing muriate on November 9, 1935.

Other companies have done considerable prospecting for potash salts in New Mexico by drilling methods since January, 1934. Their efforts have been rewarded by discoveries of beds of commercial potash salts, including both potassium chloride and potassium sulphate. Some of the holdings of these companies have been consolidated by assignments to the Union Potash and Chemical Company and negotiations are under way at this time (September, 1936) looking to the early development of these properties for the primary purpose of producing potassium sulphate, K_2SO_4. A daily production of 1,500 tons of crude salts is contemplated and tentative plans call for the erection of a refinery to be equipped for an annual production of 50,000 tons of high-grade potash salts including potassium muriate and potassium sulphate.

The capacity of the refinery operated by the American Potash and Chemical Company, at Trona, Calif., where refined muriate of potash, borax, and other sodium salts are recovered from the natural brines of Searles Lake, was doubled in 1933 and the plant is reported to have an annual capacity of 180,000 tons of muriate.

The natural brines of Searles Lake in California and the minerals mined in New Mexico have been the chief sources of potash production in the United States since 1931, but the recovery of potash from distillery wastes and from cement kiln dust also has contributed to our domestic production.

What turn in events may serve to terminate this, the fifth epoch in the potash industry in the United States remains to be seen.

Plants of the three major potash producing companies of the United States now have a combined potential annual capacity of more than 400,000 tons of

muriate equivalent to approximately 250,000 tons of K_2O, under normal operating conditions. The production capacity of one of these plants is to be greatly increased within the next few months and a fourth plant for the manufacture of potash salts is under contemplation.

The existence of deposits containing millions of tons of crude potash salts has been proven. In case of necessity the productive capacity of manufacturing plants now in operation could be materially increased by employing additional men and by adding to the hours of plant operation. It would be unwise to speculate concerning the possible production of potash salts in the United States but it is gratifying to know that American manufacturers can easily satisfy the requirements of American consumers of potash salts for many years to come and that the potash industry in the United States has been developed to such a degree that American manufacturers are now prepared to compete for world-wide markets of potash salts.

Outlook

What does the future hold for the potash industry in the United States? Now that deposits of water-soluble potassium salts comparable to the world-famed Stassfurt deposits in Germany have been discovered and are being mined in America, the casual observer probably can see nothing but an ever-increasing production of potash salts, expanding markets, and large monetary returns for the industry; but to one who studies the subject carefully, giving due consideration to present and future markets, competitive influences from abroad, possibilities of over-production, possible oppressive taxation, etc., the future does not appear so promising.

Statistical reports published by the United States Bureau of Mines for the period 1925 to 1934, inclusive, indicate that the average annual consumption of potash, K_2O, in the United States is approximately 300,000 short tons. Four hundred and twenty thousand (420,000) tons of potash (K_2O) used in the United States in 1935 marks the present peak consumption. Study of Government statistics reveals the fact that 82 percent of the total amount of potash used in the United States in 1929 was used in 20 states of the Atlantic seaboard and of the Eastern Gulf area; practically 97 percent of the total amount of potash used in the United States was consumed in states east of the Mississippi River. The geographical consumption of potash has changed but little since 1929.

The potash industry of the United States has two important centers: viz, Searles Lake, Calif., and Carlsbad, N. Mex. The plant of the American Potash and Chemical Corporation, the only potash-producing plant on Searles Lake, has a capacity of 180,000 tons of muriate a year. The present combined capacities of the plants of the United States Potash Company and the Potash Company of America at Carlsbad, N. Mex., amounts to more than 1,000,000 tons of crude salts or approximately 250,000 tons in terms of K_2O. The present combined refinery capacities of these two companies amounts to approximately 220,000 tons of high grade muriate and this refinery capacity is to be increased materially. The total capacity of the three major potash producing units in the United States as shown by the figures given is already 400,000 short tons of K_2O which compares favorably with the 420,000 tons (including imports) consumed in 1935. In addition to this, the Union Potash and Chemical Company may soon begin development of a third area in the New Mexico field for the production of crude salts, muriate, and potassium sulphate. The United States Industrial Chemical Company continues to manufacture potash from distillery wastes at Baltimore, Md., and the North American Cement Corporation continues the recovery of potash from cement-kiln dusts at Hagerstown, Md.; but the total production of the last two mentioned may be considered negligible in consideration of the subject at hand.

Production costs never have been made public by any of the three major companies and it is difficult even to estimate the costs because so many variable factors must be taken into consideration. Plant capacity, time and regularity of operations, and efficiency of operations, particularly of refinery operations, are some of the most important factors entering into production costs. Mining conditions in the New Mexico potash area are practically ideal. The deposits are rich, the thickness of the beds contributes to low-cost production, neither water nor gas is encountered in the mine workings, no timbering is required, and mining operations are mechanized throughout; but the many years of experience in potash mining and refining possessed by the German people and the extremely low wage scales in Germany should serve to compensate for any advantages in production costs which might accrue to the American potash producer because of ideal mining conditions.

Freight rates from the producing plants at Carlsbad, N. Mex., to the centers of greatest potash consumption in the eastern part of the United States makes it highly advantageous to ship muriates, thereby eliminating the freight charges on the impurities which are present in manure salts. Muriate is the only potash produced at Searles Lake.

The lowest freight rates available for shipments of potash from Carlsbad, N. Mex., to Atlantic coast ports involve rail-water transportation; these rates average $8 per ton. All-rail freight rates to points in Texas, Arkansas and Louisiana range from $6.50 to $7.50 per ton; to points in Ohio and New York, $10 per ton; to points in New Jersey and Maryland, $12 per ton.

Current freight rates on German potash from the mines in Germany to Atlantic ports in the United States are not immediately available to the writer, but according to a report published by the United States Bureau of Mines in 1927 "The (freight) rate on potash salts from central Germany to Hamburg or Bremen is approximately $1.75 per short ton." The ocean freight rate on potash salts from European to American Atlantic ports was $2.60 per short ton, according to A. E. Sanderson, of the Transportation Division, Department of Commerce. It is apparent that European producers of potash have a marked freight advantage over domestic producers in those parts of the United States which, according to Government statistics, use 82 percent of the total amount of potash consumed in the United States. Only about 18 percent of the potash market of the United States is within territory in which our domestic producers enjoy freight advantages.

Potash production in the United States has increased materially since 1931 but, like all other business, the potash industry has felt the ill effects of the general business depression which has prevailed since 1929. The industry has been subject to a paroxysm of taxation and proposed taxation.

The United States Government spent millions of dollars in efforts to find a domestic source of supply of potash to the end that the Nation might not be dependent on foreign lands for that important commodity. The search was crowned with success and today, the potash industry in the United States is an infant industry, struggling for opportunity to grow, to maturity, and to find the place which it deserves in the category of essential and national industries. It has been sponsored by courageous and able men and fostered by governmental agencies and is now a valuable national asset.

● AMONG Bureau of Mines circulars released for November are the following: Diesel Mine Locomotives, Their Development and Use in European Coal Mines, by George S. Rice and F. E. Harris; Gold Mining and Milling in the Black Canyon Area of Yavapai County, Ariz., by J. R. Guiteras; Mining, Treatment, Methods and Costs at Gifford Hill & Company Sand and Gravel Plant, by J. W. Higgs; Mining and Grinding Methods and Costs at the Clay City Pipe Company Clay Mine in Ohio, by E. J. Lintner; Mining and Milling Methods and Costs at Hogg Mountain Gold Mining and Milling Company in Alabama, by N. O. Johnson; Suggestions on the Safe Handling of Electric Shovel Trailing Cables in Open Pit Mines, by S. F. Crawford; Factors Affecting an Accident Prevention Program in Metal Mines in California, by S. H. Ash and Emory Smith.

● THE Council for Industrial Progress advocates a four-point legislative program according to Major George L. Berry, industrial coordinator. These proposals are: (1) Government aid to small enterprises; (2) Tariff revisions; (3) establishment of a permanent economic council to study the flow of national income and make long range plans to stabilize prosperity; (4) regulation of wages, hours, fair trade practices and revision of antitrust laws.

Present Tendencies in IRON ORE Preparation

By A. J. GLEASON*

FOR the past 10 or 12 years, there has been much discussion about the need for more preparation work on iron ores as a means of increasing the metallurgical and mechanical efficiencies of blast furnaces but, at this time, less than half of the iron ore from the Lake Superior District is beneficiated in any manner. It is generally conceded that blast furnace work would be expedited and improved by further preparation of the ores, but the economics involved are difficult to analyze and determine. As a consequence, changes in ore preparation practice are made very slowly. Recently, however, the necessity for further work appears to be more acute and at many mines a study of each ore is being made to obtain the basic information needed if more preparatory operations should be required.

At present, crushing is the most widely used preparation method. Most crushing is done to reduce the size of ore chunks that might otherwise have difficulty in passing through the blast furnace bell. The chunks are crushed to a maximum size of from 8 in. to 3 in. In many of the washing plants, crushing to a maximum of from 2 in. to ¾ in. is done to free additional fine gangue material.

Sandy ores are washed to remove low grade, sandy fines, and thus raise the grade of the remainder to an acceptable analysis. The removal of this fine material, ordinarily most of the minus 80 mesh sizes, improves the smelting of these ores and reduces the amount of flue dust formed.

A small amount of ore is jigged to remove coarse gangue material and this treatment also improves the smelting qualities of the ore.

Besides the screening done at the crushing plants, some is done to separate lump ore for use in open hearth practice. This separation is made at 2½ in., the undersize being shipped as an unsized merchantable ore.

At two plants, high moisture ore is sintered to remove both free and combined water and to improve the smelting of the ore. This is the only treatment that is done for the purpose of improving metallurgical action of the ore in the blast furnaces. The other concentration processes, like washing, jigging, etc., are primarily for producing grades of ore equal to the direct shipping ore and any improvement in metallurgical action is incidental.

At one mine, ore is dried for removing part of the free moisture but this process has not been more widely used on account of the dust that is formed if the moisture is reduced too far. Some ores can be dried to 5 percent moisture without becoming dusty but others are dusty at 15 percent moisture.

One semi-commercial plant is roasting jig middlings and magnetically concentrating the roasted material. The product is sufficiently coarse so that no agglomeration is necessary.

Another plant, that of the Mesabi Iron Co., is equipped to concentrate natural magnetites and to sinter the fine products. This plant has been closed since 1924.

The above is a rough summary of the current ore treatment processes, which at the present time appear to be adequate, but many furnace men believe that furnace practice could be improved by having the ore crushed finer as large pieces of ore reduce to metallic iron very slowly and, by agglomerating the real fine ore to prevent its segregation in the blast furnaces and the consequent channeling of furnace gasses. The fine ore also causes the production of flue dust which would be almost entirely eliminated by this agglomeration. While most furnace men believe that this additional preparation would improve furnace operations, it is difficult to show in dollars and cents that this improvement would justify the extra cost of this preparation, which would add from 50 cents to 80 cents to the cost of each ton of ore besides calling for large capital expenditures for treatment plants.

However, at a few furnace plants prior to 1929 an opportunity was afforded for slowly changing over to this practice and for observing the economies that were effected. These economies were greater than the expense involved but the comparison was based on the high wind pressure furnace practice of that time. After the slump in steel demand, the low wind pressure practice was adopted at many of the furnaces. Whether equivalent economies would be obtained by this ore preparation in low pressure practice is not known and it may be some time before this can be demonstrated. The situation is complicated further by the possibility that the same furnaces may hold to the low pressure practice until their capacities are strained and then revert to high wind pressure practice to produce more iron per day.

Notwithstanding this lack of conclusive figures about the relative savings by better ore preparation and the expense of obtaining it, the industry may be forced to resort to this additional ore treatment in order to produce better grades of steel, or at least in order to find out how to do so.

To produce better grades of steel, after all other means have been exhausted, better iron must be produced in the blast furnaces. To learn how to do this, the action of the furnaces must be made as uniform as possible so that the effect of any change in the practice can be easily and quickly observed. This, of course, is rudimentary in all metallurgical and chemical processing. Much progress has been made during the last 20 years in increasing the uniformity of blast furnace action, but it is the opinion of investigators both at home and abroad that such ore treatment will make the operations still more uniform. This conclusion seems to be borne out by the results obtained at the few furnaces which were burdened by such prepared ore.

Anticipating this demand for more careful preparation of the blast furnace raw materials, many of the iron ore producers are studying this problem so if the demand materializes they will have

* Mining engineer with Pickands, Mather & Co.

ABRASION AND DECREPITATION TEST

	Ave. Diam. inches	Original Material Wt.	% Wt.	Size Units	Cold Abrasion Test Wt.	% Wt.	Size Units	Hot Abrasion Test Wt.	% Wt.	Size Units
+1.05"	1.525	4.81	3.21	0.0490	3.77	2.52	0.0384	3.09	2.07	0.0316
+ .742"	0.896	5.55	3.71	0.0332	3.96	2.65	0.0237	2.78	1.86	0.0167
+ .525"	0.6335	7.18	4.80	0.0304	6.74	4.50	0.0285	5.87	3.92	0.0248
+ .571"	0.448	8.27	5.53	0.0248	7.60	5.08	0.0228	6.85	4.58	0.0205
+ 3 Mesh	0.317	10.29	6.88	0.0218	8.91	5.96	0.0189	8.58	5.73	0.0182
+ 6 "	0.197	21.25	14.20	0.0280	19.17	12.81	0.0252	18.08	12.08	0.0238
+ 14 "	0.0885	18.75	12.53	0.0111	20.32	13.58	0.0120	19.80	13.23	0.0117
+ 28 "	0.0346	13.89	9.28	0.0032	11.81	7.89	0.0027	11.13	7.44	0.0026
+ 65 "	0.0157	19.31	12.91	0.0020	20.32	13.58	0.0021	15.48	10.35	0.0016
+100 "	0.0070	8.80	5.88	0.0004	9.89	6.61	0.0005	9.32	6.23	0.0004
—100 "	0.0029	31.53	21.07	0.0006	37.14	24.82	0.0007	48.65	32.51	0.0009
Total		149.63	100.00	0.2045	149.63	100.00	0.1755	149.63	100.00	0.1528
Average Particle Diameter, inches				0.2045			0.1755			0.1528

Original particle size 0.2045"—100%
Cold Abrasion particle size 0.1755"— 85.8 or 14.2% decrease in particle size.
Hot Abrasion particle size 0.1528"— 74.7 or 25.3% decrease in particle size.
The average decrease in particle size of a large number of samples was 18.0% due to cold abrasion and 38.1% due to hot abrasion.

the answers to many of the questions that will arise. Most of this work consists in making tests on the ores from each mine to determine, if possible, their characteristics, which may influence their action in the blast furnaces.

The first requirement in an investigaton of this kind is the obtaining of representative samples. Those that are obtained regularly for analytical purposes consist of 24 small scoopfuls taken from each top of a three or four railroad car unit. Where chunks are encountered too large for the scoop used, they are broken into small pieces and a scoopful of the broken ore taken. As this changes the screen sizing of the ore, special samples have to be obtained for this investigation. This is done by taking six scoopfuls from every tenth, twenty-fifth, or fiftieth railroad car shipped, depending on the tonnage to be mined of the particular grade. This is to give an accumulated sample that will weigh 1,000 pounds or over at the end of the shipping season. The scoops used are 5½ inches long and 5 inches wide, and are shaped like a sugar scoop. They hold about 2¼ pounds. The sampling points are selected so as to give representative proportions of coarse and fine ore. Where chunks are encountered too large for the scoop, a piece of the chunk the size of the scoop is taken. The weight of the sample should be at least one hundred times the weight of the largest piece.

The first test to be made on the sample is the screen analysis or sizing test. Formerly, the screen analysis gave only the weight percentages retained on and going through 20, 40, 60, 80, and 100-mesh sieves. Later, many mines changed to 1", ⅜", ⅛", 35-mesh, 65-mesh, and 100-mesh screens. Tyler standard screens are used, the first three being the 1.050", .371", and .131" screens. Now many mines are using 4", 3", and 2" screens in addition to the others.

The screen test is made by first drying the ore and then screening out the sizes larger than 1 inch. These are screened and weighed directly. The minus 1" ore is weighed and then cut down by a Jones sample divider to an amount that can be used in a mechanical screen like the Tyler Ratap. Where drying facilities are not sufficient, the coarse sizes above 1" are screened damp, weighed, sampled, and run for moisture to determine the dry weights. The finer sizes are weighed, cut down, re-weighed, dried, and screened in the mechanical sampler after the necessary moisture samples are obtained.

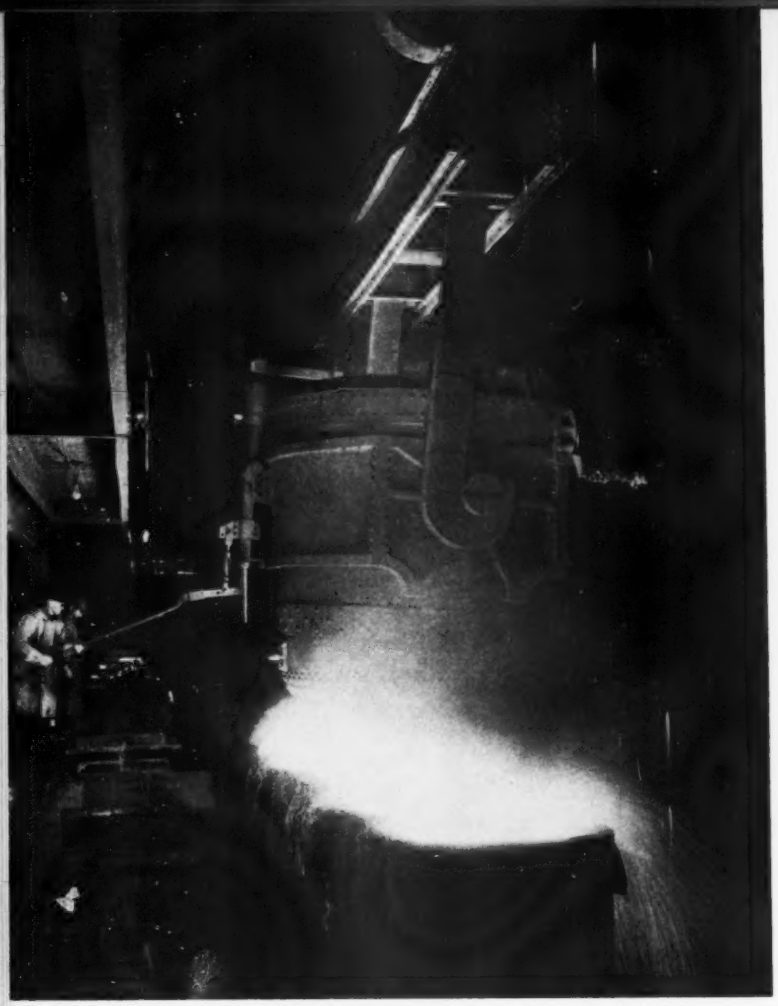
Ordinarily the fine screening is done dry, although in most metallurgical operations fine sizes are screened wet. This question was taken up with a number of blast furnace men and it was their opinion that dry screening gave them a better index of the flue dusting tendencies of an ore than wet screening would. Their assumption was that, although in dry screening fine material which sticks to the coarser pieces is weighed up and recorded with the coarser sizes, still such material in the furnaces would also cling to the coarser pieces and would act more like the coarse particles than like ordinary fines.

The objects of the screen analyses are to show the percentage of ore that may have to be crushed, if some limiting size is determined, and to give an idea of the tendency of the ore to form flue dust in the blast furnaces. Although any material that is 14-mesh size or smaller may be blown out of the furnace, the percentage of minus 65-mesh ore is taken as a measure of the flue dusting characteristics of an ore. This does not mean that all of the minus 65-mesh ore would be blown from the furnace, as the amount of flue dust depends on the furnace practice, but it is assumed that the more 65-mesh material in an ore, the more flue dust will be made under any practice.

The amount of flue dust made from any ore will be affected by the way the ore breaks down as it descends down the blast furnace stock column before reduction begins. This tendency is examined by means of decrepitation tests as described in the A. I. M. & M. E. Technical Publication No. 372, "Resistance of Iron Ores to Decrepitation and Mechanical Work," by T. L. Joseph and E. P. Barrett. These tests consist of making a screen analysis on 300 pounds of ore and then rotating it at 2½ revolutions per minute for 1½ hours in a revolving steel drum 31 inches in diameter and 49 inches long. The test is made at room temperature. After the rotation is finished, a second screen analysis is made on the ore to see how it has broken down. A second sample of the same size and of the same screen analysis as the first is similarly rotated in a drum but heat is applied by means of a gas torch burning at an opening in the drum. This torch heats the ore up to 1,400 degrees Fahrenheit. After the 1½-hour rolling, the ore is allowed to cool in the drum overnight before making the next screen analysis. With the data obtained from these screen analyses, the average particle size of the original ore and of the abraded samples are obtained. This average particle size is derived by taking the average diameter of each screen size and multiplying it by the percentage of that size. The sum of all of these products, or size units, gives the average particle diameter or size. The above tabulation shows the results of one test of an ore that should stand up in a furnace better than an average ore.

These tests will not, of course, show how much an ore will decrepitate or break down in actual furnace practice, but will show its tendency toward doing this in comparison with those of other ores. The object of these tests is to show whether an ore should be sintered or otherwise treated to prevent its breaking down and forming much flue dust.

The next tests made on the ores are the porosity tests, and these are made to determine how fine the ore should be crushed before being used in a blast furnace. These tests are based on the experiments made by T. L. Joseph, of the United States Bureau of Mines, and reported in the A. I. M. & M. E. Tech-



nical Publication No. 688, "Porosity, Reducibility, and Size Preparation of Iron Ores." This paper describes tests that were made which demonstrated that reducibility of ores increased with increased porosity of the ores. In other words, the porosity of an ore is a measure of its reducibility.

Ores which show small percentages of porosity reduce very slowly and, as large chunks reduce more slowly than smaller particles, these ores should be crushed to a size that will be reduced before it reaches the lower part of the blast furnace.

Mr. Joseph took the Provo, Utah, ore as a standard for comparisons. This ore has a porosity of 24% and after it is crushed to a maximum size of two inches, it reduces satisfactorily in the blast furnace. From the tests made on a large number of ores, Mr. Joseph concluded that ores should be crushed to the following maximum sizes for different ranges of porosity:

Percent of porosity	Maximum size of ore
5 to 10	1.0 inches
10 to 20	1.5 "
20 to 30	2.0 "
30 to 40	2.7 "
40 to 50	3.3 "
50 to 60	3.8 "

In making the porosity tests, it is assumed that ore smaller than three-eighths of an inch in diameter would not be crushed under any circumstances, and only the ore coarser than this size is used for these tests.

The procedure in making these tests is to take a sample of about 50 pounds of the plus ⅜" ore and cut out of it a sample of about 10 pounds, which is heated at 450 degrees Centigrade for 12 hours to drive off the free moisture and combined water. This is done so that the dehydrated weight of the remainder of the large sample can be computed from its natural weight.

The description of the test and the computations involved may be more easily understood by reference to the tabulation of the results of one of the tests Mr. Joseph reports in his paper referred to above. After the small dehydration test is made, the dehydrated weight divided by the original weight of the small sample gives a factor as shown on line "A" of the tabulation. The natural, or "as received", weight of the remainder of the large sample is shown on line "B". On line "C" is given the weight of the remainder of the sample if it were dehydrated. The sample is then soaked in water and drained for 15 minutes usually, or until the drops of drainage water are very infrequent. The sample is then weighed as shown on line "D". The wet sample, enclosed in a wire basket, is lowered into a full tank of water and the amount of water displaced is weighed—line "F". The apparent specific gravity is computed by dividing the equivalent dehydrated weight "C" by sum "G" of the weights of the water absorbed, when the ore was soaked "E", and of the water displaced "F". The true specific gravity of the ore is determined by cutting out a small sample of the ore, grinding it to minus 100 mesh, dehydrating it for 12 hours at 450 degrees Cent., and then weighing it in a specific gravity bottle. The difference—"I"—between the true gravity—"I"—and the apparent gravity—"H"—divided by the true gravity, gives the percentage of porosity.

Tabulation of Porosity Test Data

Line A—Factor obtained from dehydration test	.9694	
Line B—Natural weight of sample	49.12	lbs.
Line C—Equivalent dehydrated weight, A × B	47.62	"
Line D—Weight of natural ore after soaking in water	51.02	"
Line E—Water absorbed by natural ore, D — B	1.90	"
Line F—Water displaced by soaked ore	12.42	"
Line G—Total water involved E + F	14.32	"
Line H—Apparent specific gravity, C ÷ G	3.32	"
Line I—True specific gravity from —100-mesh ore	4.46	"
Line J—Difference in specific gravities	1.14	"
Line K—Porosity, J ÷ I = .2401, or	24.01%	

Such an ore should be crushed to at least two inches to insure reduction of the largest pieces in the upper part of the blast furnaces.

All of the above tests now are being made to give us some idea about the ore preparation problems that may have to be solved, but if the fine ore eventually has to be agglomerated before being fed to the furnaces, another problem arises that will have to be solved by more investigation. At present, sintering is the only workable method that can be used. It is a method that is well standardized and it furnishes a product that is very acceptable to the blast furnaces. It is, however, an expensive process, and would require very large expenditures for sintering plants if all of the fine ore were to be sintered.

Another condition that also may become acute is the deficiency of alumina in many ores, particularly concentrates. As we can expect to see more ore concentrated in the near future, a source of additional alumina will have to be found unless blast furnace practice is changed.

One of the proposed solutions to the problems of agglomeration and alumina deficiency is to use high alumina material and limestone for making a cement

to use as a binder in briquetting the fine ores. If it is possible to do this at a cost that is somewhat near the cost of sintering the fine ores, the method may be more acceptable than sintering. A small amount of work along this line has been started, but it has been towards finding a source of cheap alumina. As soon as the most economical supply of this material is found, a very large amount of experimental work will be required to perfect such a process.

In summarizing this paper, it can be stated that the demand for better steel may force the blast furnace operators to require the iron ore producers to crush their ores to some limiting size, which size will depend on the way the ore reduces in the furnace, and then screen out the fine ore to be agglomerated, so that no fine material will enter the furnace. Screening, decrepitation, and porosity tests are being made on the ores to indicate the factors that will have to be considered if such a program is required.

It is of much satisfaction to realize that such testing, involving a very large amount of work, can be done well in advance of the demand for changes in ore preparation.

Whither

(*Continued from page* 25)

which is world wide, is the forced establishment as national industries of manufactures which could be better carried out in other lands. Almost every country today seems to consider it necessary to make everything for itself. International trade is being, to a large measure, destroyed, national jealousies are fostered instead. It cannot be denied that the new spirit of "narrow" nationalism, however much it is to be deplored from the aspect of international trade and international amity, has given a gigantic stimulus to research by forcing a nation to produce within its own shores everything it possibly can for itself.

The chemist need by no means hold himself aloof from such problems as the length of the working day, the merits of three eight-hour or four six-hour shifts on continuous processes, the number of days off per week. In passing, it may be urged that the day should be devoted either to work or to play; too short a working day may involve that the individual is either too tired to play, or plays so hard that he is too tired to work.

The goal of science is the material and the spiritual welfare of man, but it is the material aim with which we have been up to now mainly concerned. There is a tendency in the rationalized mass production factory to treat the individual as a machine, indeed, almost as a chemical substance, when we prescribe rules for his health and his feeding and even his housing, forgetting that in man those things which are not measurable are more important as regards his happiness (self-expression) than those which are measurable. Indeed, the contempt for individuality under some conditions and in some lands is bringing about its factual disappearance.

We live in two different worlds—one of facts, the other of their symbols. The scientist, as the result of the study of a multitude of individuals, develops a complete science of a human being, which, however, is a different thing than an individual.

Individuality is fundamental in man—it permeates our entire being.

None the less, there is need to distinguish between what the world says it wants and what is really good for it. Luxury today is often regarded as a vice, though in the ancient world it was nearly a virtue. Certainly the luxuries of our ancestors are the necessities of today.

There are many forms of luxury, for whereas a person who adopts a luxurious life loses in adaptability and becomes more dependent on external circumstances, as has happened to all of us town dwellers, yet it is part of life itself and the only road to contentment and happiness is to have our individual luxuries, whether they be the cultivation of a garden, an interest in art or literature or architecture. It is the business of each one of us not merely to live, but to make life worth living and to try to do this for the other fellow, too. Chemists are often criticized, and I believe rightly, for being too immersed in their science and lacking other cultural interests. The fault lies, perhaps, as much with the absorbing nature of our science as with the individual. It is for us to cultivate that spirit of idealism which puts ease and safety and comfort and long life second to the achievement. It is the same spirit which brought man from barbarism into civilization and is daily bringing him out of error into truth. Wordsworth has sung of "the mind that builds for aye," and I may be permitted to conclude with a thought which Goethe puts into the mouth of Faust:

"Upon this globe of ours
For grand achievement still there's space."

Tungsten Industry

(*Continued from page* 53)

ograph needles, and a thousand other daily necessities.

The importance of *tungsten* among the *metals* in our *type* of *civilization* is comparable only with that of *lead* and *zinc*, and is *exceeded only by that* of *iron* and *copper*.

In time of war, the importance of tungsten becomes even greater. It is improbable that shells or other cut steel could have been supplied during the great World War in the quantities needed, had tungsten tools not been made available. It would have been practically impossible to find the men, machines and room necessary to turn out the munitions in the time available.

Other Uses.—Sodium tungstate has been found to make a very beautiful and pliable white leather, and is used very much the same as chromium salts are used in tanning. Tungsten is also used in hundreds of chemical compounds and for colored printing inks.

In order to be merchantable, tungsten concentrates must contain 60 per cent WO_3 or better, and be comparatively free from all injurious impurities. They are shipped to the steel mills in sacks weighing approximately 120 pounds; however, at present several of the large producers are using a steel drum container, about the size of a 15-gallon oil drum, and these are working to the utmost satisfaction.

Tungsten Resources. — Although our present resources of tungsten ores and the production of the same is not large enough to supply the entire domestic needs of the United States at the present time, yet, as I have pointed out in this article, there are thousands of properties in the United States which, if properly developed, would provide a large potential tonnage of low-grade ores.

The contact-metamorphic deposit of our great central basin will constitute such a large and important source of tungsten supply that will become available to the domestic consumer and this will form a guaranteed reserve to meet war requirements.

Our ability to meet these demands will depend entirely on the price to be paid for the product. These prices are fixed on foreign quotations which, during the last 15 years, have fluctuated from $1.50 to $10 per unit, c.i.f. New York. Therefore, the domestic producer has no yardstick by which to measure any price that he is going to receive for his ore for any length of time, and this has been the one impediment which has stood in the way of greater development of our tungsten resources. These foreign prices are made largely by Chinese producers who, with their cheap coolie labor, do not have any of our problems of fixed costs.

It is therefore obvious that without a protective duty on these ores from China the American producers would all be forced to stop production and shut down their plants.

The problem of imports and prices is largely Chinese, and as Bret Harte once said:

"For ways that are dark
And tricks that are queer,
The heathen Chinee is peculiar."

Wheels of Government

(*Continued from page* 27)

a statement shall be made as to the reasonable upper and lower limits of such value. . . ."

The representatives of the Commission do not regard this present form as the last word or as the final form. It is brought out in an effort to meet the requirements of the mining industry. By many it is regarded as too complex. The representatives of the Commission state that their object is solely to give to the public which buys securities, such information as a prudent business man or investor would desire to have in making a purchase of any form of property or fractional part thereof.

Mechanization Trends

Reports of Coal Operators Committees

Report on DE-WATERING WASHED COAL Prepared by THE DISTRICT COMMITTEE OF SOUTHWESTERN PENNSYLVANIA

THE following data covers a method of de-watering washed coal mined from the Pittsburgh seam. The bed moisture is 2.40 percent as determined by channel samples.

Moisture Sampling

Special moisture samples are taken for research only; the normal samples for moisture analysis are taken from the raw and washed coal by automatic samplers. Four samples of washed coal and one of raw coal are run daily for moisture. Samples are also taken regularly for moisture tests of heat dryer feed and discharge, filter cake, and Carpenter dryer feed.

Sample containers are sheet iron cans of 100 lb. capacity, water-tight.

Sample crushing is not done.

Sample drying is in an oven—over night at 220° F. Some determinations by Xylene.

No moisture percentage is added to the analysis determination.

De-watering Units

	Sizes de-watered	Type of unit	Moisture
Unit No. 1	4" x 0	Shaker type	2.7%
Unit No. 2	¼" x 28-mesh	Shaker type	17.0%
Unit No. 3	¼" x 28-mesh	Carpenter dryer	6.0%
Unit No. 4	28M x 0	Continuous filter	21.0%

De-watering Surfaces

	Unit No. 1	Unit No. 2	Unit No. 3	Unit No. 4
Material	Steel	Phos-bronze & stainless steel	Ascoloy	28M x 0
Openings	5/16" rd.	¼ m.m.	1/16" round	Filter cloth
Percent open area	16 percent	.....	.....	.....
Life months	12 months	12 months	3 months	1–3 months
Area sq. ft.	863–1010 *	284	.....	1,400
TPH sq. ft. over	0.40–0.343 *	0.84	.....	.....
TPH sq. ft. through	0.12–0.102 *	0.025	.....	.....
R. p. m.	150	155	350	.....
Stroke horizontal	5 inches	5 inches	.....	.....
Pitch	7 degrees	7 degrees	.....	.....

* This area includes blank approach, end plate and margins.

De-watering Methods

Unit No. 1 consists of three shaker screens which receive all the washed coal from the sealed discharge launders. This coal, including the undersize, amounts to about 450 tons per hour and carries 300,000 gal. of water per hour. The screens are 5/16-in. round, riser tread, and are on a steel frame, hung on ash hanger boards, driven by eccentrics through wooden drive rods at 150 r. p. m. No spray water is used in this unit, nor is any de-watering device ahead of the shaker.

Unit No. 2 consists of two shaker screens which receive all the washed coal from the free discharge launders, amounting to approximately 240 tons per hour, carrying with it 120,000 gal. of water per hour. The screens consist of eight sections, each of ¼-m.m. wedgewire, bolted on a steel frame which are hung from ash hanger boards and driven from eccentrics through wooden drive arms.

Before the coal and water mixture goes on to the shaker screens, it is partially dewatered by fixed wedgewire at the ends of the launders. The total area of dewatering screen at the end of the top launders is 48 sq. ft.; that at the end of the second launders is 12 sq. ft. This is all ¼-m.m. wedgewire at 18° pitch. No spray water is used on either the fixed wedgewire nor on the shaker screens.

Unit No. 3 consists of six AR-4 Carpenter dryers for the fine coal from the wedgewire shaker screen. The dryers are set in tandem, two rows under the flight conveyor which feed them. From adjustable openings in the bottom of the conveyor the dryers are fed through steel chutes. To further dewater the fine coal before feeding it to the dryers, fixed wedgewire screen is installed in the bottom of the feed conveyor just ahead of each pair of dryers. This screen is so installed in the conveyor bottom that the conveyor flight will wipe across the entire surface to keep it from blinding. This screen is ¼ m.m. and the total area 24 sq. ft.

In the dryer proper, bed angles are used on the screen plates to save wear on the screens and to keep the percentage of effluent solids as low as possible. The plant make-up water is added as flush water in the effluent chutes of the dryers.

Unit No. 4 consists of continuous vacuum filters which handle the underflow solids from a Dorr Thickener. There are two units, each an 8-ft.–6-in. machine fitted with 10 rows of discs, of 7 sectors each.

The output is 40–60 tons per hour from a feed of 30–35 percent solids. The bags used are of cloth, the filtrate is clear water, and no spray water is used on the filter. The speed of the machine may be varied according to operating requirements, and is set to give the lowest possible moisture to suit the tonnage demand of the unit.

Heat Drying

Heat drying is done in a heat dryer, which handles 150 tons per hour of 4-in. x 0 coal. The feed coal enters at 5.5 percent moisture, and the dried discharge has 3.5 percent moisture. The dryer is a revolving cylinder — 65 ft. long, diameter 8 ft.–6 in. set at a pitch of 1¼ to 12. It operates at 8 r. p. m. with a 60-hp. motor. Heat for drying is produced in a stoker-fired furnace built integral with the dryer and the hot gases

forced through the dryer by a motor-driven fan.

Air drying is not used; the coal as washed is loaded directly after it leaves the cleaning plant, without being stored in bins.

Combination of Sizes

The coal as shipped is all 4-in. x 0 size; made up of 4-in. x 5/16 coal from the shaker screens, 5/16-in. x 28M from the dryers and 28M x 0 filter cake. The following are weights and moisture contents of the above sizes in the final product:

Size 4-in. x 5/16-in. amounts to 57 percent of total weight and has 2.7 percent moisture.

Size 5/16 x 28M amounts to 35 percent of total weight and has 6 percent moisture.

Size 28M x 0 amounts to 8 percent of total weight and has 21 percent moisture.

The average of the above combined sizes has 5.3 percent moisture.

When the heat dryer is run with the washer, 25 percent of the washed coal is dried to 3.5 percent moisture. This gives an average moisture in the 4-in. x 0 coal as shipped of 4.8 percent.

—*Submitted by H. W. Major*, Committee of Southwestern Pennsylvania.

Report on DE-WATERING WASHED COAL Prepared by THE DISTRICT COMMITTEE OF CENTRAL WEST VIRGINIA

THE following data covers a method of de-watering washed coal mined from the No. 2 gas seam. The bed moisture is 2.7 percent as estimated from channel samples.

Moisture Sampling

Special moisture samples are taken for fine sizes only. For the larger sizes the results given are the averages of eight or more samples which were usually taken for ash and sulphur determinations.

Sample containers for the fine sizes are water-tight. For the coarse coal and products as loaded, the samples are usually sacked.

Sample crushing is not done for the fine sizes. For the coarse sizes the sample as taken is ground through a 00 crusher; a 4-lb. sample is then riffled from the same spout.

Sample drying is in an electric oven—over night at 220° F.

Loss in sampling.—No checks have been made to determine how much, if any, additional moisture would be shown if moisture determinations were made strictly in accordance with A. S. T. M. standards. It is also probable that moisture is lost between the taking of the gross samples and the taking of the moisture sample after the primary grinding of the coarse coal samples. Considering the above and available data, it is estimated that 0.25 percent added to the moisture figures reported will give the total moisture.

De-watering Methods

Unit No. 1 The shakers receive 220 t. p. h. of coal and approximately 1,500 g. p. m. of water from the washer. They are driven by eccentrics through flexible wooden arms and supports, 150 r. p. m., 4½-in. stroke, 8° pitch. The plus 5/16 go to the mixing conveyor or railroad cars without further de-watering. The water and 0x5/16 coal goes to a primary settling tank. The 0 x 5/16 is elevated, rewashed and delivered to Unit No. 4, from which the oversize goes to a centrifugal dryer, then to mixing conveyor and railroad cars.

Standard steel plates gave a life of about 24 months. A special alloy plate in service six years appears good for at least six more.

De-watering Units

	Sizes de-watered	Type of unit	Moisture
Unit No. 1	5/16 x 4½	Shaker	3.5%
Unit No. 2	0 x 5/16	Cent. dryer	6.4%
Unit No. 3	60 x 14M	Vibrating screen	25.8%
Unit No. 4	48 x 5/16	Shaker	12.7%

De-watering Surfaces

	Unit No. 1	Unit No. 2	Unit No. 3	Unit No. 4
Material	Steel	Stainless steel	Stainless steel	Bronze wedgewire
Openings	5/16 rd.	1/16	60 M	¼ m.m.
Percent open area	40.8	.....	32.3	10.8
Life months	24	4	6	24
Area sq. ft.	108	46	42	46
TPH sq. ft. over	1.56	.96	.14	.96
TPH sq. ft. through	.47	.08	.06	.13
R. p. m.	150	350	250	180
Stroke inches Hor.	4½	.....	1½	2½
Pitch	8 degrees	.....	1 degree	6 degrees

Unit No. 2 The centrifugal dryer is driven by 50-hp. motor at 350 r. p. m., rated capacity 75 t. p. h. Average feed estimated 50 t. p. h., 0 x 5/16. The screens used in dryer are of stainless steel 3/32 in. thick with 1/16-rd. openings. Average life of plates, four months. The effluent goes to the primary settling tank.

Unit No. 3 This screen is similar to Unit No. 1, but is driven by steel arms at 250 r. p. m., 1¼-in. stroke, minus 1° pitch. The deck has 42 sq. ft. of 60-mesh stainless steel wire screen, supported on ½-in. mesh rubber-covered screen. The underflow returns to the primary settling tank. The 60 x 14-mesh material recovered amounts to about 6 t. p. h. Eight samples showed moisture ranging from 21.3 to 31.4 percent—averaging 25.8 percent.

Unit No. 4 This screen is similar to Unit No. 1, but is driven at 180 r. p. m., 2½-in. stroke, 6° pitch. The feed is 50 t. p. h. of 0 x 5/16 over 46 sq. ft. ¼-m.m. bronze wedgewire, profile C, 10.8 percent open area. Profiles B and K have been tried but C gave most satisfactory results and a life of 24 months, compared with 12 months for B or K.

The oversize goes to dryer in Unit No. 2. The water and undersize go to a cone from which the underflow is pumped to a 70-mesh gravity screen. The gravity screen underflow which is high in ash and sulphur goes to the slate boot. The overflow from slate boot goes to primary settling tank—average 6 percent solids. The underflow from slate boot is wasted. The oversize from the gravity screen goes to a settling cone from which the underflow is fed to screen in Unit No. 3.

Combinations of Sizes

0 x 6-in., consisting of 0 x 4½ washed, and 4 x 6 hand-picked, 64 samples, 3.8 percent.

0 x 4½-in., all washed, 18 samples ranging from 4 to 5.7 percent, average 4.7 percent.

0 x 2, all washed, average for year 5.7 percent.

NOTE: A consumer sampling the 0 x 2-in. coal from this mine showed the following percent of average moisture before this plant began washing coal, and after:

Two years unwashed coal at destination, average moisture 4.3 percent.

Eight months washed coal at destination, average moisture 5.2 percent.

—*Submitted by T. W. Guy*, Committee of Central West Virginia.

News and Views

of Interest to Mining Men

● ON January 1, Kennecott Copper Corp. resumed copper production at Ray and Chino mines. The Ray property has been closed down since April, 1933, and Chino since October, 1934. Rehabilitation of the plants has been under way for the past two months. On September 1, last, Kennecott instituted a substantial production increase at the Utah Copper Co.'s property.

● UNITED STATES silver production for the period January-October, 1936 totaled 51,116,000 fine ounces.

● A RECENT report of the Bureau of Census shows that for the first 10 months of 1936 the sale of mechanical stokers for residential purposes increased 86.48 percent. Stokers for apartment houses and small commercial heating jobs increased 31.46 percent. General commercial heating and small high pressure steam plants increased 20.09 percent. Large commercial and high pressure steam plants increased 43.40 percent.

● NINETY men lost their lives from accidents in and about coal mines in the United States during October, 1936. Reports covering the first ten months of 1936 show that 979 men have been fatally injured in the coal mines of this country, 780 at bituminous mines, and 199 at anthracite mines.

● PROGRESS REPORT NO. 2 on investigation of detachable rock drill bits by McHenry Mosier is an information circular published by the U. S. Bureau of Mines and covers a national survey of detachable bits in metal mines. It presents comparative costs for drilling with conventional and detachable bits, describes the reconditioning of drill steel and gives various data on rock drilling.

● THE COUNCIL for Industrial Progress has recently released a pamphlet giving an analysis of production, wages and employment in manufacturing industries from 1914 to 1935. Copies may be obtained from the Coordinator for Industrial Cooperation, Tower Building, Washington, D. C.

● THE fiftieth annual meeting of the Coal Mining Institute of America was held at the Fort Pitt Hotel, Pittsburgh, Pa. Among the papers presented was "Treated Mine Timbers," by A. R. Joyce, Wood Preserving Corporation; "Studies of Roof Movement," by E. R. Maize, United States Bureau of Mines; "Most Essential Factors Introduced in Bituminous Mines in the Past 50 Years to Decrease Hazards in Mining," by A. R. Pollock, general manager, Ford Collieries Company; "Fifty Years' Progress in Mechanization of Coal Mines," by Charles Robinson, Kellys Creek Collieries Company; J. D. A. Morrow, president of the Pittsburgh Coal Company, made the principal address at the annual dinner. Dean E. A. Holbrook served as toastmaster. A number of other papers were presented and the meeting was very successful from every standpoint.

● COPPER and brass fabricators are operating at about 95 percent of capacity. The demand for copper, brass pipe and tubing is coming mainly from the building trades, and it is estimated that the total consumption of these products for 1936 will be 15,000,000 pounds more than in any previous year.

● THE IDAHO MARYLAND MINES CORPORATION, Grass Valley, Calif., has recently completed and placed in operation its new 300-ton mill at its King Midas Mine. The new mill is equipped with a crushing plant, ball mill, concentrating tables and flotation units.

● AMONG Bureau of Mines releases for November is an interesting paper on "Production of Explosives in the United States During the Calendar Year 1935," presented by W. W. Adams and V. E. Wrenn. Manufacturers reported a total production of 308,381,250 pounds of explosives. Coal mines consumed 81 percent of the total production of blasting powder and 99 percent of the total output of permissible explosives, which average 39,170,016 pounds. Metal mines used 27¾ percent of all high explosives other than permissibles. Quarries and non-metallic mineral mines consumed 17 percent of the high explosives other than permissibles. Construction work required the largest quantity, 40 percent of all high explosives manufactured during the year.

● DOMESTIC stocks of all grades of slab zinc at the end of November totaled 57,527 tons, the lowest since September, 1929, according to figures released by the American Zinc Institute. The combined value of lead and zinc shipments by Tri-State mines and tailing mills for the first 44 weeks of 1936 reached $13,531,240. The district produced and shipped during this period 361,140 tons of zinc, valued at $11,448,690. They also produced 42,100 tons of lead concentrates valued at more than $2,000,000. The Webb City and Oronogo lead and zinc fields near Joplin, Mo., have been reopened after having been closed down for the past 18 years.

● NATIONAL COAL ASSOCIATION through its Bituminous Coal Research, Inc., recently released technical report No. 3 on "Efficiencies and Costs of Various Fuels in Domestic Heating." The report covers the study conducted by the Battelle Memorial Institute in cooperation with the Research Committee. A survey in American Research and Coal Utilization in 1936 has also been completed by the Research Committee.

● FORTY-FOUR million eight hundred thirty-three thousand twenty-three gross tons of iron ore were shipped by the Lake Superior producers during the season now closed. This tonnage far exceeds estimates early in the year showing an increase of 28 percent over the 35,000,000 tons estimated as the 1936 production. The gain over 1935 was 58 percent, total production in that year being 28,362,368 tons.

● APPROXIMATELY 1,900 employes are affiliated with the Social Security Board at Baltimore and the office is now in full operation. A battery of 300 alphabetical card-punching machines, the largest single installation of its kind in the world, is employed in the work of setting up accounts. Fifty-five sorting machines with a combined capacity of 5,000,000 operations daily, and 56 tabulating machines, capable of handling a million cards daily, will be used by the accounting unit.

● THE OUTPUT of gold, silver, copper, lead, and zinc from lode and placer mines in Arizona in 1935, in terms of recovered metals, was 241,754.60 fine ounces of gold, 6,601,280 fine ounces of silver, 278,029,289 pounds of copper, 15,566,100 pounds of lead, and 6,673,932 pounds of zinc, according to C. N. Gerry and Paul Luff, of the Salt Lake City field office of the U. S. Bureau of Mines. Comparative figures for 1934 were 167,024.12 ounces of gold, 4,448,474 ounces of silver, 178,082,213 pounds of copper, 6,877,216 pounds of lead, and 1,810,279 pounds of zinc. The value of gold production increased from $5,837,493 in 1934, to $8,461,411, silver from $2,875,781 to $4,744,670, copper from $14,246,577 to $23,076,431, lead from $254,457 to $622,644, and zinc from $77,842 to $293,653. The value of the metal production in Arizona from 1903 to 1935 was $2,593,570,010, of which 89.66 percent represents the value of the copper; 5 percent the value of gold; and 4 percent the value of silver.

● THE IMPORTANT features of 1935 in Arizona mining were the reopening, in January, of the United Verde mine at Jerome, the reopening, in September, of the Inspiration Consolidated property at Inspiration, the marked increase in the production of copper ore from the

New Cornelia and Miami mines, the large gain in the output of siliceous gold ore from the mines at Oatman, Katherine, Mammoth, Hillside, Cordes, and Octave, and the increase in the output of lead-zinc ore from Ruby, Santa Cruz County. Of the total gold 236,597.60 ounces were recovered from lode mines and 5,157.00 ounces from placers.

● THE OUTPUT of silver in Arizona in 1935 increased 48 percent over the output in 1934 and most of it (69 percent) was recovered from copper ore; the remainder was recovered chiefly from siliceous ore and lead-zinc ore. Nearly 62 percent of the state's silver in 1935 came from the Copper Queen branch at Bisbee, United Verde at Jerome, Eagle-Picher at Ruby, Magma at Superior, New Cornelia at Ajo, United Verde Extension at Jerome, and the Hillside north of Hillside.

● OF THE total copper produced in Arizona in 1935, 276,469,902 pounds were recovered from copper ore and 67 percent of the total production came from three mines operated by the Phelps Dodge Corporation. The largest producer of copper in Arizona in 1935 was the New Cornelia mine; it was followed by the Copper Queen, United Verde, Magma, Miami, and United Verde Extension mines. The total value of the metals recovered from copper ore and precipitates was $30,161,989, or 81 percent of the total value of the gold, silver, copper, lead, and zinc produced in the state.

● THE LARGE increase (more than 8,500,000 pounds) in the output of lead in Arizona in 1935 over the output in 1934 was due chiefly to the increase in the production of lead-zinc ore from the Eagle-Picher property at Ruby and lead ore from the "79" mine near Hayden Junction. Nearly 61 percent of the total lead was recovered from lead-zinc ore, 30 percent from lead ore, and 7 percent from siliceous gold ore. The Eagle-Picher Mining & Smelting Co. was as usual the largest producer of lead in Arizona; it was followed by the "79," Tombstone (Bunker Hill), and Tombstone Extension properties.

● THE HANNA FURNACE CORPORATION, a division of the National Steel Corporation, has completed plans for the construction of a battery of coke ovens. It is estimated their cost will be approximately $6,000,000. Hanna Furnace makes the pig iron requirements for the Greater Lakes Steel Corporation.

● DOMESTIC price of lead has been raised approximately $8 a ton; 6 cents a pound, New York, and 5.85, St. Louis, the highest price since 1930. At the same time export copper prices rose to the equivalent to 11.40 cents a pound c.i.f. European base ports, a new high for this metal.

Sees Sales Gains In 1937

Langbourne M. Williams, Jr.

● LANGBOURNE M. WILLIAMS, JR., president of the Freeport Sulphur Company, anticipates improved prospects for that industry in the coming year, provided unreasonable and excessive taxation does not interfere with this development. In a recent statement Mr. Williams said:

"The year 1936 for the sulphur industry was marked by a satisfactory increase in business due to the sustained rate of activity enjoyed by large users of sulphur, such as fertilizer plants, steel mills, acid plants, paper mills, rubber factories, and others.

"Production figures for the entire year have not been compiled, but it is estimated that approximately 2,000,000 tons of sulphur were mined by American producers. This reflects an increase of nearly 22½ per cent over the 1,632,590 tons produced in 1935.

"For 1937, the sulphur industry should again enjoy sales gains in proportion to the general increase in industrial activity. Sulphur itself is a basic industrial and agricultural necessity and plays an integral part in scores of manufacturing processes. For this reason its production figures have long been regarded as an index of general business prosperity.

"The industry in 1936 faced increased competition from foreign producers whose output of both pyrites and crude sulphur was expanded. Many of these countries were aided in their production activity by governmental help in the form of high tariffs and direct subsidies.

"The competition which confronts the American sulphur industry consists not only of the production of crude sulphur (brimstone), but also in the form of pyrites, smelter gasses and other by-products. When viewed in its relation to the total consumption of the element sulphur, the proportion of the market enjoyed by the American brimstone producers is far less than is commonly supposed. The fact is that in 1935 America's brimstone producers accounted for less than 26 per cent of the total world production of sulphur.

"The chief barrier to progress faced by the American sulphur industry, in addition to increased foreign competition, has been an increase in severance taxes in the sulphur-producing states. However, the action of the Texas Legislature in reducing to $1.03 a proposed severance tax of $2 indicates a growing realization in the South that unreasonable and excessive taxation tends to drive away capital, prevents the development of new industries, and retards general prosperity which would give employment to thousands of people. The action in Texas, it is hoped, presages an era of better understanding in the South between governmental bodies and industry which will quicken the pace of industrial activity in that region and make for greater development and expansion.

"During the past year, research experts and scientists have been studying many new uses for sulphur, particularly in the field of agriculture, and the results of these studies should prove of great benefit to millions of farmers. The Freeport Sulphur Company has been cooperating with state agricultural colleges and farm experiment stations in an attempt to perfect many of the operations involved in these new uses for sulphur.

"Expansion of agricultural markets during the past year has convinced the sulphur industry that it has much in common with the farmer. We are considering his problems as our problems and striving through scientific research to ease the farmer's burden and add to his profits.

"The year 1937, I believe, will see a continuation of this growing alliance between industry and agriculture, with attendant benefits to the country as a whole."

● BITUMINOUS coal production in the United States for the week ending December 19 was approximately 10,225,000 net tons, being approximately 2,000,000 tons greater than for the same period in 1935.

● MONTANA SOUTHERN MINES COMPANY has finished its 100-ton flotation concentrator, near Pony, Madison County, and has started operations under the direction of Milton I. Leydig, president and general manager.

New Secretary

● EVAN JUST succeeds M. D. Harbaugh as secretary of the Tri-State Zinc and Lead Ore Producers Association. He is a graduate of Northwestern University and of the University of Wisconsin, both in geology. Has been engaged in geological and engineering work both

Evan Just

in connection with the mining and the oil industries. He taught one year at Lehigh University and three years at the New Mexico School of Mines. He leaves a position as production engineer for the Carter Oil Company, at Seminole, Okla., to take his new position about January 1.

Foundation to Encourage Research

● SPURRED by a dual desire to stimulate scientific development in the arc welding field, and to honor the pioneer work of its president in promoting arc welding and perfecting and developing arc welding equipment and electrodes, The Lincoln Electric Company has just completed its long-contemplated plans for establishing a fund and foundation to encourage study and research for benefit of the industry.

This new fund, which was voted by directors of the company at the turn of the year, has been named "The James F. Lincoln Arc Welding Foundation." Objects of the foundation, and the significance of its name, are best set forth in the inaugurating resolution just adopted by The Lincoln Electric Company's board. This states in part:

"WHEREAS it is desired in the public interest that careful and extensive scientific study, research and education in respect of development of the arc welding industry be encouraged; and

"WHEREAS the comparatively recent developments of electric arc welding disclose a vast field of study and research which yet is in its infancy . . .; and

"WHEREAS through such study and research the public and modern industry should have the benefit of accurate knowledge and information in matters affecting the application of electric arc welding to machinery and equipment; and

"WHEREAS it is the desire of this company to assist in furthering said objects and to provide suitable rewards therefor: Now, therefore, be it

"*Resolved*, That The Lincoln Electric Company should, and it does hereby, found, create and establish for such purpose, a scientific educational fund and foundation, which shall be organized and operated exclusively for the purposes as set forth in this resolution; and further, as a token of its esteem and respect for James F. Lincoln, and for his wide experience and interests in said scientific subjects, it denominates such as 'The James F. Lincoln Arc Welding Foundation'."

Principal direction of the foundation's work will be given by Dr. E. E. Dreese, chairman of the department of electrical engineering of the Ohio State University.

Other trustees who will serve with Dr. Dreese on the foundation are W. B. Stewart, distinguished member of the Cleveland Bar, and H. R. Harris, vice president of the Central United Bank of Cleveland.

Acceptance by Dr. Dreese of his important position with the Foundation places its program on the highest possible plane, and assures the carrying out of studies which will view arc welding with full regard to both its economic and social significance.

After receiving the second electrical engineering doctorate degree ever given by the University of Michigan, in 1929, Dr. Dreese was appointed professor of electrical engineering at the Ohio State University, and in February, 1930, was made chairman of the department.

He is author of numerous papers presented before the American Institute of Electrical Engineers, of which he is an outstanding member. His other connections with the field of science include membership in the Society for Promotion of Engineering Education, and in Tau Beta Pi, Sigma Xi, and Eta Kappa Nu honorary fraternities.

Commenting on the honor just bestowed upon him, President James F. Lincoln states:

"The world is just becoming aware of the rise of a new industrial process which holds economic and social significance of the highest order.

"In laboratory and in mill and factory the world around, scientists and technicians are seeking to develop new phases of the electric arc as a superior welding technic.

"Already, their persistent pioneering has brought forth amazing results. With

Jas. F. Lincoln,
President, Lincoln Electric Co.

the aid of the electric arc, many industrial methods, together with new processes of incalculable benefit have been made commonly available.

"Yet, so recent is the development of arc welding as a practical process, its full benefits have been experienced by not more than one in five potential users.

"It is indisputably a fact that every manufacturer, every engineer, every merchant, and every consumer of virtually every product now made has a vital interest in further development of the arc welding process—in speeding the widest possible acceptance of this comparatively new method which produces so much better for so much less.

"As a consequence, I feel signally honored in having my name attached to a foundation which will seek to help the arc welding industry improve and extend its benefit.

"The sole purpose of this new foundation is to challenge the attention of manufacturers whose products benefit society; and to stimulate the ingenuity of every engineer and skilled worker interested in extending the frontiers of knowledge and achievement.

"This arousing of interest through the foundation will result, I believe, in lower production costs for thousands of devices and commodities now employed in manufacture or moving in commerce, and will give constantly increasing markets the benefit of better, stronger and more serviceable goods."

It is expected that directors of the foundation will complete their organization of a comprehensive program at an early date, and that the foundation will announce the first of its activities by the close of this month.

"Proximate Coal Analyses"

● A NEW publication, Mac's "Proximate Coal Analyses," compiled by William C. MacQuown and published by the Coal Information Bureau, Inc., is now available for immediate delivery. This publication contains proximate coal analyses on the majority of the mines in the United States, alphabetically ar-

ranged by the name of the mine, followed in each instance with the following data—location of mine (county and state), operator, name and address of selling agents, date and origin of analyses, as well as data on the condition of the sample, size and seam, followed by the proximate analysis (moisture, volatile, carbon and ash) together with sulphur, british thermal units and fusing point of the ash.

An alphabetical list of coal operators is also included showing the name and location of mines (county and state), to be used in locating the name of mine when operator only is known. In addition to the above, data is included on the description of the ultimate and proximate analyses of coal and method used to determine the proximate analysis to collect the sample, prepare the sample for analysis and make the proximate coal analysis. In order that any special or private analyses can be listed in the same publication, a number of ruled blank sheets have been provided.

● THE American Zinc Institute announces that it will present its educational exhibit in 1937 at the following points: Pennsylvania Farm Show, Harrisburg, Pa., January 15-27; Northwest Lumbermen's Convention, Minneapolis, January 19-21; Ohio University Farm Week, Columbus, Ohio, January 25-29; Illinois Lumber and Material Dealers Convention, February 9-11; and Wisconsin Retail Lumbermen's Association, Milwaukee, February 16-18.

● NATIONAL LEAD COMPANY, through its president, F. M. Carter, announces that on January 1 it revised its existing pension plan to provide retirement incomes independent of and addition of old age benefits payable in the future by the Government under the Federal Security Act. Seven thousand employes are involved. To accomplish its objective the company terminated its existing pension plan, one of the oldest in the country, and the new plan which is actually a combination of two separate plans was instituted on January 1.

Socorro, New Mexico

● THE State Bureau of Mines and Mineral Resources announces the publication of a revised edition of the "Oil and Gas Map of New Mexico," by A. Andreas, the revisions being to July 15, 1936. The original map, by Dean E. Winchester, was published in 1931, and was included in Bulletin 9 of the Bureau, "The Oil and Gas Resources of New Mexico." The map shows the location of nearly 200 anticlinical structures in the State, and also the location, total depth, and results (by symbol) of approximately 1,200 wildcat wells. Known oil and gas fields, pipe lines, refineries, etc., are shown. The scale is 1 to 1,000,000. The price is 75c printed on paper and $1.25 mounted on cloth.

NORTHWEST MINING ASSOCIATION MEETS

Left to right—A. W. Dickinson, of the American Mining Congress; D. I. Hayes, American Zinc Co.; Lewis P. Larsen, Pend Oreille Mines and Metals Co., and Arthur Campbell, State Mine Inspector of Idaho.

● THE CONVENTION held in Spokane, Wash., December 3, 4 and 5, by Northwest Mining Association, was the most successful held there in years. This organization is 42 years old and claims to be the oldest mining association in the United States. Bliss Moore and Charles P. Robbins, both of Spokane, are president and secretary, respectively.

Optimism in mining circles throughout the Pacific northwest, made the session a lively one, and the importance of problems between the mining industry and the Government drew influential mining men and Government officials. Harold H. Neff and F. W. Boericke, of Washington, D. C., were present, representing the SEC and held long conferences with officials of the association who are struggling to secure concessions from the commission in order that the financing of mining enterprises may be less difficult. The association is striving particularly to relieve companies desiring to raise less than $30,000 of what are considered burdensome conditions imposed by the commission.

Donald A. Callahan, of Wallace, gave the chief address at the annual banquet. "The time has come when the mining industry must organize to protect itself against hastily enacted and untested laws," he said. "We have seen the centralization of power in Washington without testing the good or bad of it. Only time will tell. There is only one thing that can destroy this nation, that is the clamy hand of government itself."

A. W. Dickinson, of Washington, D. C., representing the American Mining Congress, gave an address at one of the sessions. Others were given by E. A. White, manager of the Tacoma smelter; Judge Charles W. Beale, of Wallace, Idaho; Dr. Phil J. Shenan, of the United States Geological Survey; Frank J. Cotter, representative from Alaska, and others.

The long tunnel which will be nearly a mile when completed, which is being driven by the American Zinc, Lead and Smelting Company to secure deep development in the property of Metaline Mining and Leasing Company, at Metaline Falls, Wash., was described in detail by D. I. Hayes, of St. Louis, western representative of the company and engineer in charge. It is now in nearly 2,000 ft.

"The tunnel is 8 by 8 ft.," Mr. Hayes said. "Thirty-lb. rails are used to provide a 24-in. gage track on one side of the tunnel. The other side is used for drainage ditch, air lines, water lines and ventilating tubing. * * *

"Each heading shift completes the cycle of drilling, blasting and loading the blasted rock of at least one round in a shift. The average round completed in one shift is 8 to 9 ft. Two 3½-in. rock drills with automatic feed are used to drill out a round. One drill in first class repair is kept available at the heading for quick change in case of trouble with one of the machines. Each of the two drills is set up on a vertical column with a 4-ft. arm. The drill crew consists of three machine men and a helper. An extra machine man is carried to insure normal drilling progress in case one of the experienced men is forced to lay off. An average round consists of approximately 26 8½ to 9½ ft. holes.

"Time required to set up machines, drill out and blast varies from three to five hours depending on the formation.

The tunnel to date has cut directly across the bedding of a sedimentary formation. The cars and mucking machines are of special design for this work. The cars are 3-ton capacity with body 8 ft. long and 42 in. wide and 49 in. high. The track is on one side of the tunnel close enough to the rib so that the car just clears the rib. This is to permit the use of a cherry picker to hoist an empty car to one side of a trip of cars so that empty ones can be supplied at the mucking machine with a minimum of switching delay. The cherry picker consists of an air cylinder and piston hung from a crawl that rolls on a 3½-in. jack bar that is set up across the back of the tunnel. The cherry picker is portable and is moved up frequently to permit quick car switching during mucking. The mucking machine is actuated by compressed air. It consists of a light weight but powerful air hoist mounted on a track portable loading ramp and slide and a 7 cu. ft. scraper. A blasting round usually amounts to from 60 to 75 tons or broken rock. Time required to muck out a round, including setting up and removing the muck, is from two to three hours.

"A 5-ton storage battery locomotive is used for haulage and switching. Transportation distance will soon require two locomotives during mucking."

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Items on Montana mines furnished by the Montana Mining Association.

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● JARDINE MINING COMPANY has just issued a booklet covering its quarterly report for the period ended October 1, 1936. A very complete report of operations is given by Newton W. Emmens, general manager. Net operating income for the period is given at $12,689.49, treating about 125 tons per day. The company is now bringing its capacity up to 300 tons per day and improving its metallurgical process, under the supervision of George G. Griswold, Jr., famed Butte metallurgist, who also is a director in the company. The company has an authorized capital of 1,000,000 shares of $1 par stock, of which 657,877 are outstanding.

● AT THE November meeting of the Montana Section of the American Institute of Mining and Metallurgical Engineers, A. S. Richardson, head of the ventilation department of the Anaconda Copper Mining Company, made an address on the workings of his department, the meeting being held in his laboratory, where he demonstrated the different machines and apparatus used in testing underground air, especially for dust particles. He was followed by Prof. Melville Sayre, of the staff of the Montana School of Mines, who spoke on Archeological Problems of Montana. Dean Milnor Roberts, of the University of Washington, was a guest.

Harbaugh Joins Lake Superior Iron Ore Association

● M. D. HARBAUGH has assumed his new position as Vice-President of The Lake Superior Iron Ore Association, and becomes executive in charge of its offices in the Hanna Building, Cleveland. He comes from Miami, Okla., where he leaves a position as Secretary of the Tri-State Zinc and Lead Ore Producers Association which he has held since June, 1929.

Mr. Harbaugh was born in Kansas City, Mo., May 18, 1892, and was reared there. After graduating from high school, he was employed for two years on a surveying party with the Kansas City Park Department, and then spent three more years partly with the city and partly with the Kansas City Terminal Railway, in responsible positions in surveying, drafting and construction work on a variety of municipal, railway, and other projects in and about Kansas City. For the next two years he was employed as an engineer on railway valuation work, first in Arkansas on field work for The Interstate Commerce Commission, and later in the offices of the Kansas City Terminal Railway. From 1917 to 1919 he was with the Missouri Highway Department as a field engineer and construction superintendent.

In 1919, Mr. Harbaugh enrolled in the Department of Mining Engineering at the University of Wisconsin. He graduated in 1923, after serving as instructor in surveying one season at the Devils Lake Engineers Summer Camp, spending one summer again on railroad valuation in Missouri, and two summers on geological mapping in northern Wisconsin with the State Geological Survey. As an upper classman, he was for two years research assistant to Professor W. J. Mead of the Department of Geology, working on problems in structural geology.

Following graduation, he went to the Kentucky-Illinois fluorspar district for a year, in charge of diamond drilling and other exploration for the Aluminum company of America, under the direction of Professor Mead, consulting geologist. After geological examinations for the Aluminum Company relating to a proposed dam and a hydro-electric tunnel in the Great Smoky Mountains in the summer of 1924, Mr. Harbaugh returned to the University of Wisconsin as instructor in Engineering Geology. He took the M.S. Degree in the spring of 1925 and continued graduate studies and professional work during his affiliation with the university until June, 1927. The next two years were spent in examinations of mineral properties in areas ranging from British Columbia and Newfoundland to Mexico, and included field work as consulting geologist for the geophysical prospecting firm of Mason, Slichter and Gauld.

From June, 1929, to December, 1936, Mr. Harbaugh was Executive Secretary of the Tri-State Zinc and Lead Ore Producers Association of Oklahoma, Kansas and Missouri. His work there was statistical, technical and engineering in nature, much of it dealing with public relations, freight and other utility rates, taxation, workmen's compensation insurance, and other matters concerning economic and labor problems. In the interests of the zinc and lead industry, he has been an active member of the American Zinc Institute and the American Mining Congress.

Mr. Harbaugh is the author of magazine and newspaper articles on technical and economic subjects, and co-author of "A Story of the Tri-State Mining District" and a comprehensive technical paper on the "Milling Practice in the Tri-State District."

He is an active member of the American Institute of Mining and Metallurgical Engineers, has served as Secretary and Director of the Tri-State Section since 1929, and is a member of the Committee on Mining Geology. He is also a member of the engineering and scientific fraternities—Tau Beta Pi, Sigma Xi, and Gamma Alpha, and of various civic organizations including the Rotary Club.

Mr. Harbaugh was married May 31, 1924, to Marjorie Bangs Warvelle of Chicago. Their children are John, Daniel, Philip, Marjorie and Sylvia.

● NEIHART CONSOLIDATED SILVER MINING COMPANY, of Neihart, Cascade County, has given a four year lease on its property to the Silver Mining & Milling Company, according to W. A. Brown, of Great Falls, treasurer. The leasors will pay a sliding scale royalty of from 12½ percent to 20 percent. The property, which formerly produced silver ores, has been shut down since 1924.

● THE wholesale sales of all waste materials, including scrap iron and steel and non-ferrous scrap metals, amounted to approximately $400,000,000 in 1935, it was stated by Benjamin Schwartz, Director General of the Institute of Scrap Iron and Steel. This figure was based on a preliminary report just issued by the Census Bureau, covering wholesale distribution for the year 1935, in connection with the Census of Business conducted for that year. Forty-eight hundred establishments in the waste materials trade reported a volume of $394,-

034,000, which represented an increase of 45 per cent over 1933.

Operating expenses for all firms amounted to $57,536,000, including a payroll of $30,704,000. Out of the total number of establishments, 4,420 were active proprietors and firm members. The average number of employes for the entire year amounted to approximately 30,000. The stocks on hand at the end of the year were estimated at $33,325,000.

Robert Emmet Tally

Robert Emmet Tally, distinguished mining engineer, past president and director, the American Mining Congress and past president and director, the American Institute of Mining and Metallurgical Engineers, died December 7 after a short illness. He was 59 years old and made his home in Prescott, Ariz., although he spent considerable time in New York City.

The industry suffers a distinct loss in the death of Mr. Tally. He was a leader of men and industry; an advocate of a sound and workable plan for stabilization of the mineral industries. He was one of the most progressive operators and led the way in establishing efficiency in production methods. He was a staunch advocate of practical industrial relations, and was beloved by all who knew him.

Born in Virginia City, Nev., the son of T. J. and Jane D. Tally, he studied engineering at the University of Nevada and the Nevada School of Mines, receiving degrees of Mining Engineer and Bachelor of Science. He was affiliated with the various mining camps in western United States and Canada after his graduation, working as a miner, engineer and assayer. He became associated with the United Verde Copper Company 29 years ago, and established an enviable record at that property. He retired from active service, when his company was acquired by the Phelps Dodge Corporation. It was largely due to his guidance that this company progressed from a comparatively small mine to one of the nation's important copper producers. As an employer he adopted the premiums wage and group insurance systems and his company provided hospitals and recreation grounds for the workers. He served as arbitrator in many disputes in the copper industry and in one of his many published articles outlined his philosophy as follows: "The employer should take an active interest in worthy civic affairs. * * * He should have genuine affection and regard for his men and take a keen personal interest in their welfare. He should understand their viewpoint and endeavor to correct them when wrong. Men who have grown old in the service of an employer are entitled to every possible consideration not only from the standpoint of justice but as an example to the younger men." Mr. Tally served as president of the American Mining Congress, 1929-30, and was a director for many years, taking an active part in its work. He was chancellor of the Board of Regents of the University of Arizona and much credit is due him for the advancement of the university. He also was a member of the Mining and Metallurgical Society of America.

William Wearne died after a brief illness at his home in San Diego, Calif., on November 30 at the age of 64. He is survived by his wife, son and daughter. Mr. Wearne became associated with the Inland Steel Company in 1906, and was superintendent of the Laura Iron Mine on the Mesaba Range until his retirement in 1935. All of the developments of the company with respect to iron mining took place under his supervision. He developed the company's mines on the Cuyuna Range, and later supervised the taking over of the Morris and Greenwood mines on the Marquette Range.

—*Personals*—

William N. Rossberg, mining engineer of Los Angeles, formerly general manager of the Montana interests of the late Senator W. A. Clark, is doing professional work in Montana and Idaho.

L. T. Putman was recently elected president of the Winding Gulf Coal Operators Association. Other officers elected were: **J. A. Hunt,** vice president; **P. C. Graney,** secretary-treasurer, and **H. M. Scott,** assistant secretary.

William G. Caperton, vice president, Scotia Coal & Coke Co., Charleston, W. Va., was elected president of the New River Coal Operators Association at its annual meeting early in December. Other officers elected were Gilbert Smith, general manager of the Dunedin Coal Company, vice president; **T. M. Snyder,** vice president of the Koppers Coal Company, treasurer; and Stanley C. **Higgins,** secretary.

W. P. Chinn

W. P. Chinn has retired as general manager for Pickands, Mather and Company in the Lake Superior District, effective January 1, 1937. **A. D. Chisholm** has been appointed to the position of general manager for this district.

J. J. Foster has been appointed assistant to **R. E. Salvati,** general manager of the Island Creek Coal Company.

Jerome C. White has been promoted to assistant production manager for the Pittsburgh Coal Company.

George W. Brown has been appointed superintendent of the Edgewater Mine of the Tennessee Coal, Iron and Railroad Company.

Samuel Barker, Jr., consulting engineer of the Butte Copper & Zinc Company (subsidiary of Anaconda) has returned to Butte from Mexico City. He was accompanied by Mrs. Barker.

Frederick C. Gilbert, Butte mining engineer and secretary of the Mining Association of Montana, has returned to Butte after making a mine examination in Oregon for eastern capitalists.

Samuel M. Cassidy has resigned as superintendent of the Saxton Coal Mining Company and **James S. Anderson,** formerly with the Madison Coal Corporation, has been appointed to the position.

William B. Daly, general manager of mines of the Anaconda Copper Mining Company, Butte, is making a business and pleasure trip to California, New Mexico, and Arizona and probably will be gone about six weeks.

Dr. L. E. Young, vice president of the Pittsburgh Coal Company, has been proposed for a two-year term as director of the American Institute of Mining and Metallurgical Engineers. Dr. Young was a recent Washington visitor, cooperating with the Bureau of Mines in outlining its work.

Wm. R. Chedsey

Wm. R. Chedsey, head of the Department of Mining, the Pennsylvania State College, has been elected president of the Coal Mining Institute of America which is now starting its fifty-first year of service to the coal industry.

L. W. Shugg, General Electric Company, Schenectady, N. Y., has been elected president of the Exhibitors Advisory Council, Inc. The Council is a non-profit fact-finding organization, composed of leading industrial and trade companies who present exhibits of their products. It will furnish complete data on all types of shows.

Warren Prosser, mining engineer, Denver, Colo., was a Washington visitor during the month. Mr. Prosser is very much interested in aviation, flying his own plane. He took an active part in the development of the convention of the Western Division of the American Mining Congress, held in Denver in September.

James F. McCarthy, of Wallace, Idaho, president of the Hecla Mining Company, was elected a director of the Northwest Mining Association at its annual meeting.

Herbert Fitzpatrick has been elected head of the Van Sweringen interests. He is now vice president and general counsel of the Chesapeake and Ohio Railway.

J. A. Krugler, of New York, has been appointed general sales manager of the Taylor-Wharton Iron and Steel Company, High Bridge, N. J., effective December 1, 1936. Mr. Krugler succeeds J. C. Taylor, Jr., who recently resigned.

James J. Carrigan, Anaconda Copper Mining Company, has been elected president of the Montana Society of Engineers.

A. T. Thompson has resigned as secretary and treasurer of the Phelps Dodge Corporation effective January 1, 1937. **James E. Fisher** has been elected treasurer and assistant secretary, and **George R. Drysdale** has been elected secretary and comptroller.

Howard I. Young, president of the American Zinc, Lead & Smelting Company, is an ex-officio member of the "Galvanizers Committee," a new permanent organization combining the technical groups of the steel and zinc industries. Mr. Young is also president of the American Zinc Institute and the American Mining Congress.

R. C. Allen, vice president, Oglebay Norton & Company, is the official candidate for president of the American Institute of Mining and Metallurgical Engineers for 1937.

D. C. Gilbert was recently elected president of the Ophir Milling Company of Utah, a newly incorporated company.

Charles H. Segerstrom announces that Carson Hills Gold Mining Corporation, at Melones, Calif., of which he is president, has completed construction of the 800-ton mill unit. Both the crushing and cyanide plants of this company have been enlarged.

J. B. Putnam, formerly of Pickands, Mather & Co., attorney of Cleveland, Ohio, was in Washington on December 11. Mr. Putnam recently returned from a European trip.

A. C. Wilby has been appointed manager of public relations for the Chicago district of the Carnegie Illinois Steel Corporation. Previously Mr. Wilby was assistant to the president for the Universal Atlas Cement Company. Wm. Voight, Jr., has been appointed to a similar position for the Pittsburgh district of this company.

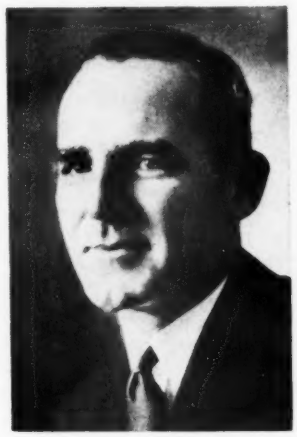
O. G. Leichliter, for many years general superintendent of the Weirton Coal Company, has resigned as of January 1, 1937, and will devote all his time to the affairs of The Mudge Oil Company, of which he is vice president and general manager, and with which company he has been connected since its organization.

William Loach, president of the Wolf Tongue Mining Company, Boulder, Colo., has returned to his home after an eastern trip, which included Washington.

J. W. Allen, Inspiration Copper Company, spent several days in Washington during the month.

Charles O'Neill has been elected president of the newly created United Eastern Coal Sales Corporation, which will market coal produced by the Rochester and Pittsburgh Coal Co., J. H. Weaver Company and Barnes and Tucker Company. Twenty-one mines are involved and a number of coke ovens with a total capacity of 50,000 tons per day.

J. J. Sellers, West Virginia Coal & Iron Co., Roanoke, Va., was a Washington visitor early in December. Mr. Sellers is cooperating with the Operators Committees of the American Mining Congress.



George W. Potter

George W. Potter has been elected vice president of the Eagle Picher Lead Company.

W. R. Storms sailed from San Francisco late in November to join the staff of the H. A. Wendt & Co., Ltd., of Manila, Philippine Islands. He was formerly connected with the United States Bureau of Mines.

R. E. Salvati, general manager of the Island Creek Coal Company, has returned to his home at Holden, W. Va., after an extended vacation in Italy and France.

C. W. Gibbs, general manager of the Harwick Coal and Coke Company, Pittsburgh, Pa., has been elected general chairman of the executive committee of the Mining Section of the National Safety Council.

Social Security

● WITH 35 state unemployment compensation laws already approved by the Social Security Board, Kentucky's law pending approval, and one (Delaware) state legislature considering such legislation, the entire program received a jolt when a three-judge Federal court in Alabama declared that state's law invalid. The decision does not directly affect the Federal Act, and the court did not pass upon the constitutionality of the national law.

The court, sitting in Montgomery, Ala., held that the state act violated both the state and Federal constitutions because (a) of unfair expropriations of employers' funds without compensating benefits, (b) classification (restricting Act to eight or more employes) is arbitrary and violation of due process, (c) impairs the obligation of contracts between employes and employers. The suit was brought by the Gulf States Paper Corporation, and Southern Coal & Coke Company. A permanent injunction was granted by the court against the State of Alabama, restraining it from enforcing the Act.

It was understood in Washington that Alabama state officials planned an immediate appeal to the Supreme Court of the U. S., jumping the intermediate circuit court of appeals. The Supreme Court, a few weeks ago, held the New York unemployment compensation law valid by a surprising 4 to 4 decision without setting any precedent for future cases by expounding the law.

Meanwhile, the only pending test of the Federal Act itself was also before the supreme court on a request for a writ of certiorari. The case is that of a stockholder of the Boston & Maine Railroad, who attacked the validity of the Federal Act and the 1 per cent tax it levies on employers for 1936. The Federal District Court in Boston held the Act valid and dismissed the stockholders' suit. This week, in an attempt to secure an early ruling, counsel for the stockholder jumped the Circuit Court of Appeals and is seeking to have the Supreme Court take the case. Whether the Supreme Court will accept jurisdiction will be known probably within the next two weeks.

Through either the Alabama or the Boston test case a definite ruling on constitutionality of the unemployment compensation section of the Federal Social Security Act is expected. If the Alabama decision is upheld or the Boston decision reversed, a precedent would be set for similar action in other states whereby state laws would become inoperative and the Federal Act would mean nothing.

● ABOUT 100 representatives attended the Minnesota section of the American Institute of Mining and Metallurgical Engineers held in Duluth, Minn., December 8. W. L. Taylor, of Hibbing, was elected chairman of the section for the coming year. E. W. Davis, of Minneapolis, and P. G. Harrison, of Crosby, Minn., were elected vice chairmen. S. E. Atkins, of Duluth, was reelected secretary.

● UNION MINERS of the Utah Park City district voted three to one to end their strike which closed three mines in the area. Approximately 1,200 employes of the Silver King Coalition, the Park-Utah Consolidated and the Park City Consolidated mines will return to work.

The action of the Park City workers brings to a close the state-wide strike called on October 9 by the International Union of Mine, Mill and Smelter Workers. As a result of higher lead prices, operators agreed to a 25 cent per day wage increase and no discrimination against strikers.—*G. P. Dispatch.*

● WORTHINGTON PUMP AND MACHINERY CORPORATION will absorb its subsidiary, Carbondale Machine Corporation, as of January 1, 1937. Carbondale organization, products, and sales activities, will be continued as a division of Worthington.

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● WORTHINGTON PUMP AND MACHINERY CORPORATION has released a four-page folder giving information on screw feed drifters for light, medium and heavy duty. Copies are obtainable upon request.

● INGERSOLL-RAND COMPANY has recently released a six-page folder which describes a new 150-lb. drifter, which they term "the fastest drill that Ingersoll-Rand has ever built." It is known as the DA-35, and copies of the folder may be had by addressing the company at 11 Broadway, New York City.

● THE SOCONY VACUUM OIL COMPANY, INC., has received an income tax credit of more than a million dollars from the Bureau of Internal Revenue, which is allowed because of foreign taxes accrued during the taxable years of 1922 and 1925 and paid subsequent to the filing of the Federal income tax returns.

● AMERICAN MANGANESE STEEL COMPANY has issued a profusely illustrated catalog describing their materials, handling pumps, pipe line fittings, and rotary dredge cutter heads. Copies are available at 389 E. 14th Street, Chicago Heights.

● GERARD SWOPE, president, General Electric Company, in a recent statement, said: "At this time last year we stated we expected a continued improvement in business for 1936, but the outlook was not particularly good for capital goods in the public utility and transportation fields. This has been borne out. The public utilities have followed in 1936, as in previous years, the policy of giving the consumer the benefit of lower rates. As a result the use of electricity has continued to increase so that in 1936 we had the largest consumption of electric energy ever reached in this country. The people of the United States now use over four times as much electric power per capita as the rest of the world. For 1937 we look forward to a continuance of improvement in business. As the increased use of electric energy continues, of course there will be a decrease in the margin of surplus generating capacity, which is so essential to the rendering of good service to the public. Hence it will be necessary for the utilities to increase their plants, with a consequent expansion in orders for heavy goods, which are so much needed in our shops and to restore general employment in capital goods industries."

● EFFECTIVE December 15, the big new Armco Ironmaster Band broadcast over a 26-station coast-to-coast NBC blue network will be heard on Tuesdays at 10 p. m., E. S. T., according to announcements by the sponsors, the American Rolling Mills Company, of Middletown, Ohio. "We are of the firm conviction that all kinds of products made of iron and steel sheets will establish new sales records within the next few years," W. W. Sebald, Armco vice president in charge of sales, said in a recent interview. The public is being reminded to tune in the Armco program through advertisements in 52 metropolitan newspapers. They have a combined circulation in excess of 14,000,000 copies, aggregating more than 50,000,000 potential readers.

● ANNOUNCEMENT is made by Link-Belt Company, 2045 W. Hunting Park Avenue, Philadelphia, of the development of a new type of inexpensive box car loader for handling bulk materials without creating a lot of dust or degradation in the loading operation.

The anti-friction belt conveyor constituting the loading element of the machine, is supported on a horizontal boom which is arranged so it can be racked back and forth, or rotated 360 degrees, by hand, on the castor-mounted truck on which the boom is mounted. The conveyor is operated at a comparatively slow speed, and has a discharge height of 5 ft.

● A FOLDER describing the advantages of Armco galvanized paintgrip sheets has just been issued. Paintgrip is a new Armco galvanized sheet metal that is readily paintable without special acid treatments or weathering. Forming qualities, soldering practice, welding, cleaning and finishing operations are described in the folder. Paintgrip is available in base metals of Armco ingot iron, copper-bearing steel or plain steel.

● ROBERTS AND SCHAEFER COMPANY, engineers and contractors, Wrigley Building, Chicago, announce that upon the affirmative approval of approximately 95 percent of all of its creditors, the U. S. District Court at Chicago on December 22, 1936, approved the plan of reorganization, and this company will continue to function with all of its old vigor and efficiency.

● WHAT is believed to be the first projection of a talking movie on an aeroplane in flight took place November 18 about a TWA Douglas transport plane, according to *Storage Battery Power*, published by the Thomas A. Edison Co. The Universal picture, "Flying Hostess," requiring a total projection time of approximately 1 hour and 25 minutes was the feature picture shown. The equipment consisted of a 32-volt Victor projector for 16 mm. film with sound track, receiving power from an Edison steel alkaline battery of 112½ ampere hour capacity.

● "RACE HORSE SPEED WITH DRAFT HORSE ENDURANCE," is the theme of a new 12-page book No. 1795, picturizing the advantages of Speed-o-Matic hydraulic power control of the mechanical operations of Link-Belt crawler shovels, draglines and cranes, as compared with the laborious manipulation of conventional long-throw mechanical levers. Speedier operation, greater output, elimination of operator fatigue, are features claimed for the new control. A copy of the new book may be obtained from Link-Belt Company, 300 W. Pershing Road, Chicago, or from the company's nearest office or shovel distributor.

● BULLETIN No. R-69 was recently issued by the Manganese Steel Forge Company. The Bulletin is of interest to those who have maintenance difficulties due to abrasion or breakage of metal parts.

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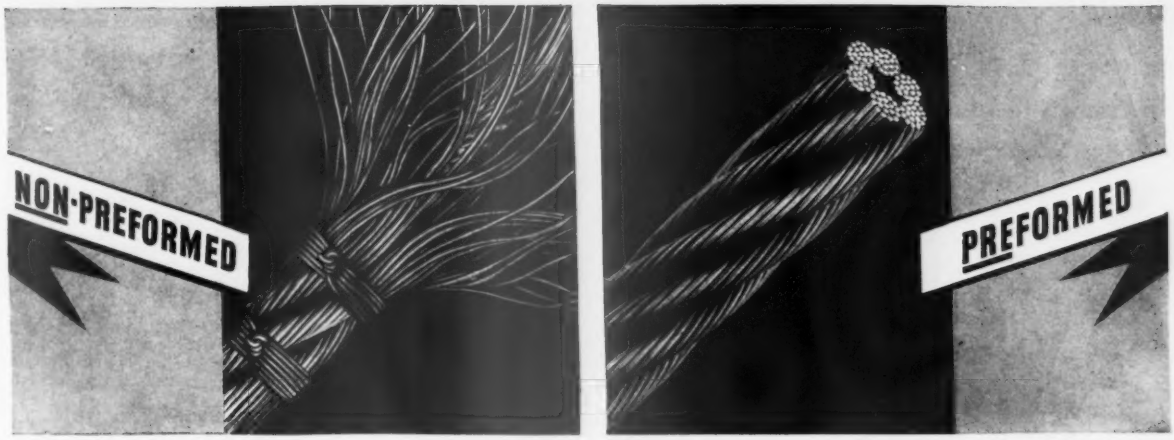

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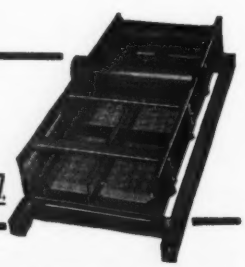

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